OCT 18 1924 Medical Lib

Subscription Price:
United States and Canada, $6.00 Per Year.
Great Britain, 25 Shillings; Single Copies, 2 Shillings.
Foreign, $6.00 Per Year; Single Copies, 75 Cents.

VOLUME VI OCTOBER, 1924 NUMBER 6

THE JOURNAL OF INDUSTRIAL HYGIENE

AND ABSTRACT OF THE LITERATURE

OFFICIAL ORGAN OF
THE AMERICAN ASSOCIATION OF INDUSTRIAL PHYSICIANS AND SURGEONS

EDITOR, UNITED STATES
DAVID L. EDSALL, M.D., S.D.

HONORARY CONSULTING EDITOR
THOMAS M. LEGGE, M.D., D.P.H.

EDITOR, GREAT BRITAIN
E. L. COLLIS, M.D., M.R.C.S.

A Survey of Dry Cleansing Methods in the Vicinity of Boston, Mass.

An Epidemic of Lead Poisoning Caused by the Sandpapering of Automobile Bodies

Industrial Psychiatry

Status of the Occupational Disease Question in Ohio, Based on Official Figures Retrospect and Prospect

PUBLISHED MONTHLY BY HARVARD MEDICAL SCHOOL

EDITORIAL AND BUSINESS OFFICES : : 55 VAN DYKE STREET, BOSTON 17, MASSACHUSETTS
GREAT BRITAIN : : INDUSTRIAL WELFARE SOCIETY, 51 PALACE STREET, WESTMINSTER, S. W. 1

Entered as second-class matter, at the Post Office at Boston Mass., under Act of March 3, 1879. Published Monthly.
Copyright, 1924, by Harvard Medical School.

THE JOURNAL OF INDUSTRIAL HYGIENE

PUBLISHED MONTHLY

VOLUME VI | OCTOBER, 1924 | NUMBER 6

A SURVEY OF DRY CLEANSING METHODS IN THE VICINITY OF BOSTON, MASS.*

W. J. CONNELL, M.D., R. W. LAMSON, PH.D., AND PHILIP DRINKER, B. S., CH.E.

From the Department of Ventilation and Illumination, Harvard School of Public Health

INTRODUCTION

IN metropolitan communities such as Boston, there are always a number of firms conducting dry cleansing and dyeing establishments. Usually the oldest and best known houses enjoy a well-deserved reputation of doing good work. Furthermore, the well-known firms usually cater to retail rather than wholesale customers. Another group, less known to the public, but of equal importance, conducts its business mainly on a wholesale or contract basis. In the latter case, prices are lower than those charged by the retail houses.

It was stated to the writers by persons in a position to know the facts that the general standards in the cleansing business were extremely low—that in many establishments the cleansing was done inefficiently and under conditions of filth of which the public has little conception. It was claimed that these improper conditions were unfair to the public and that they constituted a possible menace to public health.

*Received for publication May 14, 1924.

As the result of conferences between Dr. Parmenter, of the Harvard School of Public Health, and representatives of the New England Association of Dyers and Cleaners, the Consumers' League of Massachusetts, and the American Laundry Machinery Company, it was decided that a survey of conditions in the Boston district would be undertaken by the Harvard School of Public Health.[1] This paper is taken in large part from our report of the survey.

OBJECTS OF INVESTIGATION

The objects of this investigation were: (1) to survey existing conditions in representative plants using various processes; (2) to point out improper conditions and inefficient cleansing processes and to suggest methods for their improvement; (3) to determine standards of cleanliness, particularly of the solvents used; (4) to study the sorting,

[1]The survey and resulting report were conducted by the writers, Dr. D. C. Parmenter, and R. M. Thomson.

handling, receiving, and shipping of garments; (5) to study ventilation from the standpoints of health and fire risks; and (6) to find out whether or not dry cleansers' solvents, the drying process, and the pressing of finished garments have bactericidal effects.

Dry Cleansing Process

The term "dry" implies cleansing by means of liquids free from water. The process is intended particularly for goods which would be damaged by washing in soap and water, for goods of such a nature that washing is impractical, and, lastly, for goods soiled with greases, oils, etc., which soap and water would not satisfactorily remove. The careful treatment applied in modern and well-conducted cleansing establishments is possible because of the highly mechanized state of the industry. The modern dry cleansing plant has eliminated the careful handwork and long period of time needed to carry out this process at home and has substituted for handwork equally, if not more, effective mechanical methods.

Dry Cleansing Solvents

A great many solvents may be used in dry cleansing, but for reasons of economy and practical plant operation present practice appears to limit the cleansers to two, naphtha and benzol, with carbon tetrachloride as a third possibility.

The cleansing liquid must be a powerful solvent for grease, oils, tar, fats, etc.; it must not injure the goods or cause shrinkage; and it must be readily and completely volatilized at moderate heat—otherwise the removal of the smell of the solvent from the finished garments is difficult or impossible without detriment to the garment. Unfortunately, most liquids fulfilling these requisites present serious fire hazards in both their liquid and their vapor phases, have characteristic odors which are often difficult to remove, and present toxic hazards of varying degrees of seriousness. These obstacles can be and are overcome in well-conducted and properly ventilated establishments.

Naphtha

Naphtha or gasoline is a name given to hydrocarbon mixtures of rather indefinite composition obtained by distilling crude petroleum. Naphtha boils over the range of approximately 60° to 190°C. and has a specific gravity of about 0.75 at 15.5° C. Distillates collected over this range in temperature are colorless, have a characteristic but not disagreeable odor, and increase in specific gravity in passing from the lower to the upper boiling ranges.

The cheapness of naphtha to the cleanser lies in the fact that he can accept a product which distils over such a wide range. The entire range has solvent action on most of the grease and other spots encountered by the dry cleanser, but the higher the boiling range of the naphtha, the harder it is to remove the odor from the cleansed goods. For this reason, specifications limiting the specific gravity (and hence the boiling range) of the original naphtha are highly advisable.

Benzol

Commercial benzene in this country is known as benzol. Benzene is a definite chemical compound with a specific gravity of 0.878[2] and a boiling point of

[2]The specific gravity of commercial benzol may be lower than this figure.

79.70° C. The greatest percentage of benzol, as bought on the market, is benzene, but the commercial product increases in cheapness somewhat with the range in boiling points, with the specific gravity, and with the content of benzene. A good grade of commercial benzol is a satisfactory liquid for dry cleansing. Its most important commercial source at present is the manufacture of coke, where it is obtained as a by-product.

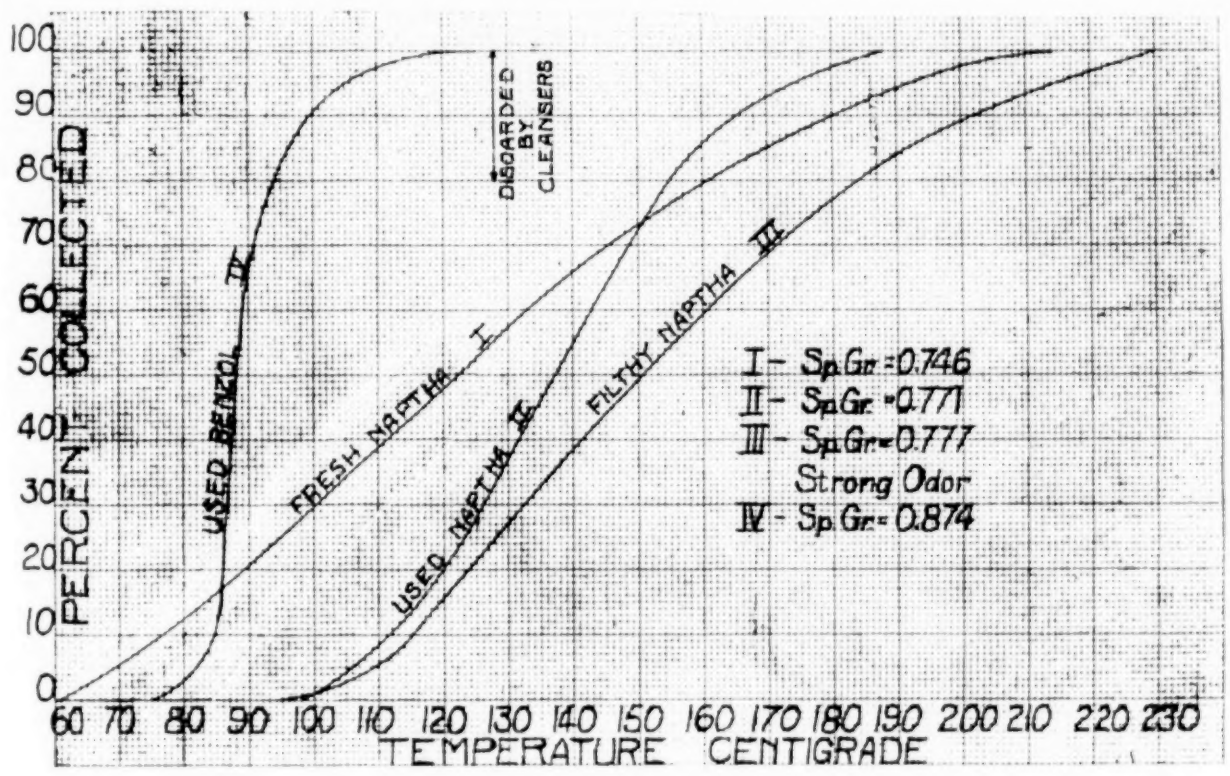

FIG. 1.—Distillation curves of dry cleansers' solvents.

Carbon Tetrachloride

Carbon tetrachloride is a definite chemical compound, an excellent solvent for most greases, fats, oils, etc., and non-inflammable—so much so that it receives wide use as a fire extinguishing agent. It has not yet found general favor in the dry cleansing industry, probably because it is rather expensive, and because the odor is difficult to remove.

Boiling Point Curves

A convenient and reliable method of comparing these solvents is by their boiling point or distillation curves (see Fig. 1). Of the liquids under consideration—naphtha, benzol, and carbon tetrachloride—the range in boiling points and specific gravity is greatest in the case of naphtha, and shortest in the case of commercial carbon tetrachloride as it is the purest, chemically speaking, of the three liquids.

Naphtha.—A typical naphtha distillation curve is shown in Curve I, which represents dry cleansers' naphtha as received at the plant. Solvent lost by unavoidable volatilization during the dry cleansing process is made up largely of the low specific gravity or low boiling liquid characterized by the first portions of the curve.

Used Naphtha.—Curve II is the distillation curve for a sample of used naphtha from a plant in this vicinity. The boiling range and specific gravity show that appreciable amounts of the more volatile fractions had been lost during the dry cleansing processes. In practical plant operation, this loss is inevitable. In order to be used again, this naphtha should be diluted with fresh solvent to bring down the specific gravity and boiling points.

Benzol.—Curve IV represents a sample of benzol which had been used and

was ready to be distilled in the plant in question. The product was far from saturated with dissolved materials, and the boiling range was much narrower than in the case of any of the other solvents shown. It should be noted that the specific gravity is 0.874, which is far higher than would be permitted by the U. S. Army specifications discussed elsewhere in this paper. In our opinion, this benzol is satisfactory for use by the cleansers, and the removal of the odor from clothes cleansed in a solvent with such a short boiling range and such a low final distillation temperature is comparatively easy. All the benzol received from this particular plant was in good condition as compared with the naphtha used in the best plants.

Filthy Naphtha.—Curve III represents the best and cleanest sample from a group taken in a plant operating the so-called "continuous" process. Although the solvent was allowed to settle for forty-eight hours and was centrifuged for thirty minutes at high speed, it was impossible to read black print of this size through more than ¾ inch depth of the liquid. The specific gravity and viscosity were high. On distillation, the residue emitted a nauseating and powerful odor. This was noticed in fractions of the distillate beginning with 160°C. With the odor appeared a yellow color which increased in depth as the temperature increased. Both odor and color were due, presumably, to the breaking up of organic matter—precisely the material that dry cleansing will remove very effectively from garments.[3] It would have been impossible to use this distillate in cleansing clothes, as the odor was powerful and could not be removed at the permissible drying temperature. A second distillation removed neither odor nor color. It is an interesting fact that the odor in this particular sample was not present in the original material before distillation. Also, it was almost completely removed by treatment with adsorbents like activated charcoal or Darco, plus small amounts of caustic soda solution.

[3]The manager of an excellent cleansing establishment told us that he had several times found mice in the linings of clothes received at his plant. If such a catastrophe should pass undetected and any portion of the animal find its way to the still, the resulting odor in the collected distillate would probably be much like that which we found in the Curve III sample.

General Outline of Dry Cleansing Processes

Two distinct methods of dry cleansing are in use in this vicinity; they are known as the "batch" and the "continuous" systems. The preliminary sorting and final drying and finishing of the garments are the same in both systems; the difference between them lies solely in the process of cleansing. In both systems there are a number of distinct steps, and for the sake of clearness the two processes will be described separately. The steps in these descriptions apply to the handling and use of both garments and solvents.

Batch Process

The steps in the batch process are: (1) sorting, (2) cleansing, or first wash, (3) extracting, (4) rinsing, (5) clarifying, (6) filtering, (7) distilling, (8) drying, and (9) spotting and pressing.

Sorting.—In certain carefully conducted plants, goods received at the plant are sometimes wrapped in individual parcels or boxes; in others, they come in by the truck load in baskets or boxes without any individual wrappings. At the plant, they are given some sort of marking or tag for identi-

fication and are sorted into (*a*) lights, (*b*) silks, (*c*) grays, (*d*) darks, (*e*) furs and small rugs, and other less important classes.

Cleansing, or First Wash.—The modern automatic cleansing machine produces an admirable degree of agitation without tearing delicate fabrics. The machine rotates first in one direction and then abruptly changes and rotates in the opposite direction. The cleansing liquid consists of naphtha or benzol plus dry cleansers' soap—an emulsion of oleic acid in naphtha or benzol with or without the addition of a certain proportion of ammonia. (In certain plants ammonia alone is added and no soap is used.) The treatment in the cleansing machine lasts from fifteen to forty-five minutes, depending upon the nature of the garments, the rush of work, and other factors of less importance.

Extracting.—At the end of the run the garments are taken from the machine, placed in large basket centrifuges, known as extractors, and centrifuged for about ten minutes. This process frees the goods of a large percentage of the solvent and enables the cleanser to recover it. In some plants the goods, instead of being removed from the machine before the rinse, are allowed to remain in it, and the dirty naphtha is run off and fresh naphtha run in. Extraction in this case would be carried out at the end of the final rinse.

Rinsing.—After the goods have received a preliminary cleansing with naphtha or benzol plus soap and have passed through the extractors, they are again placed in a cleansing machine and are given a final rinse for about fifteen minutes with clean, fresh naphtha without the addition of soap. After the rinse, the garments are again extracted and the liquid from the cleansing machine and from the extractor can then usually be employed as the first wash for another batch, provided that the suspended matter has been removed from the solvent.

Clarifying.—Much of the dirt removed by the cleansing process is suspended matter, as distinguished from dissolved matter. It can be removed by centrifuging the solvent at high speed. The efficacy of this treatment, which is known as clarification, depends very greatly upon the nature of the liquid in which the suspended matter is contained. The dry cleansers' clarifiers that we have seen are of two types, the Sharples and the DeLaval. Both operate in much the same manner as milk separators. Provided that they are cleaned at frequent intervals, they are very effective for the purpose for which they are intended. The more dissolved material the solvent contains, however, the more thick and viscous it becomes and the more difficult it is to remove the suspended matter.

Filtering.—After the used solvent comes from the clarifiers in the batch process, it may be filtered or distilled, or both, to remove the dissolved material and such suspended matter as is not taken out by the clarifiers. Filtering consists in passing the solvent through a material such as fuller's earth, which has certain adsorbent as well as filtering properties, or treating it with an adsorbent such as Darco, which will remove practically all the dissolved materials which give the used solvent its objectionable odor.

Distilling.—Many plants omit the filtering operation and distil the liquid coming from the clarifier. The stills operate under steam heat, and it is the usual practice to reject the last 20 per

cent. remaining in the still at the highest boiling range.

Drying.—The clothes which have received the final extraction after the final rinse are dried in hot rooms or tumbled about in mechanical driers through which hot air is drawn by suction or blown by pressure. In either case, the object is to remove entirely the odor from the cleansing solvent. We found that the drying temperature varied from 120° to 170°F. (48.9° to 76.7°C.) in different plants.

Spotting and Pressing.—After drying, the garments go to the spotting and pressing department, where spots not removed by the cleansing solvent are taken out by appropriate hand treatment. They are then pressed by hand on mechanical presses heated by live steam or gas. Sometimes the heat from the press brings out spots, such as those caused by sugar, which were not seen before pressing, and these are removed by the spotters. After spotting and pressing, the goods are returned to the receiving room, where they are checked, repaired, and shipped out of the plant.

Continuous Process

The steps in the continuous process are: (1) sorting, (2) cleansing, (3) extracting, (4) clarifying, (5) drying, and (6) spotting and pressing.

Sorting.—The sorting in the continuous process is carried out in the same manner as in the batch process.

Cleansing.—The same type of cleansing machine is used in this process as in the batch process. The garments are covered with the requisite amount of solvent of varying degrees of cleanliness or dirtiness and are subjected to a treatment of fifteen to thirty minutes' duration. During the entire treatment, the solvent passes from the cleansing machine through the clarifiers and back again into the machines.

Extracting.—This is carried out in the same manner as in the batch system.

Clarifying.—As already noted, clarification is carried out at the same time as the cleansing operation.

Drying, Spotting and Pressing.—These steps are the same in the continuous and in the batch systems.

From the above brief descriptions, it is evident that the continuous process requires no final rinse with clean solvent, and that the main method by which the solvent is purified intentionally is by clarification. The solvent is also allowed to remain in settling tanks overnight and the next morning, at the beginning of the day's work, the supernatant fluid is pumped into the cleansing machines. A few plants have filters or stills, but their use is unusual.

Discussion of Dry Cleansing Processes

From the foregoing outlines it will be realized that it is easily possible for cleansers to become lax in carrying out the various steps of the process when they wish to turn out the maximum quantity of goods in the minimum time and with the use of the minimum amount of solvent. To make these possibilities clearer, it seems pertinent to quote a portion of the U. S. Army specifications, which are rather exacting.

SPECIFICATIONS FOR CLEANING AND PRESSING ARTICLES OF UNIFORM, CLOTHING AND EQUIPMENT

Open Rotary and Smith System:

1. (a). Goods shall be washed in *Benzole, Naptha,* or *Gasoline,* gravity of which shall not be less than 56 degrees by Hydrom-

eter test.[4]

(b). One gallon of *cleaning fluid* shall be used to every 2 pounds of goods.

(c). Two ounces of Standard dry cleaning soap shall be used to every 10 pounds of goods.

(d). One ounce of 26% ammonia shall be used to every 25 pounds of goods.

(e). All goods shall be washed 30 minutes and rinsed 15 minutes.

(f). All clothing must be extracted for a period of not less than 3 minutes between the wash and the rinse.

(g). *Cleaning or washing fluid* to be used once; rinsing fluid once, only for rinsing, after which it may be used for washing fluid, once only by adding soap and ammonia as specified in Paragraphs (c) and (d).

(h). All cleaning fluid used for washing shall be *new, distilled, or clarified.*

(i). All cleaning fluid used for rinsing shall be *new* or *distilled.*

(j). After cleaning, all goods shall be inspected and all spots removed by a process known as "spotting," after which, if garments are not satisfactory, they shall be steam cleaned by the following method: Goods to be immersed in water temperature of hand heat, which contains enough *carbonated soda* to soften the water, after which they shall be brushed with a *neutral soap and water at hand heat*, after which they are to be rinsed in two waters at hand heat and dried as in (2b).

Drying:

2. (a). After goods are cleaned they shall be run in a drying tumbler at a temperature not less than 160 degrees for 30 minutes, the temperature to be taken at point of discharge of air from tumbler.

(b). After goods are wet cleaned, they shall be dried in a drying room or open air at a temperature not exceeding 160 degrees Fahrenheit.

It would be impossible for a cleanser who followed these specifications to do anything but efficient work, and he would never obtain solvents such as those represented by Curve III.

Well-conducted establishments in this vicinity do not weigh the goods placed in the cleansing machine, nor do we feel that such weighing is necessary. In our opinion, they more than make up for this by intelligent sorting of the goods and by not *overcrowding the cleansing machines.* In the army, goods are probably received in a state of dirtiness exceeding that of the goods handled by the average cleanser. In our opinion, it is imposing an unnecessary, impractical, and unenforceable rule on the cleanser to require him to use definite amounts of solvents and soap per unit weight of goods. Testing the original cleansing solvent and the solvent coming from the end of the final rinse for dissolved and suspended matter is just as good a control over the effectiveness of his methods—provided that he is required to cleanse for a definite minimum length of time.

Continuous Process

In many industries requiring extraction, continuous processes are used. When properly controlled, they are often more economical and more effective than batch processes. Doubtless the originator of the dry cleansers' so-called "continuous" process had good intentions, but the process we have seen in operation is, chemically speaking, nothing short of absurd.

In industries employing true continuous processes, the principle on which the processes are based is "counter-current extraction." A series of extraction apparatus is used. In the first are contained the greatest percentage of the extractable materials, and these are treated with solvent having the least extractive power—that is, solvent nearly saturated. After this first treatment, the extractable material receives a second treatment with solvent more nearly

I.e., degrees Baumé. Neither commercial benzol nor pure benzene can have such a low specific gravity. Benzine, naphtha, and gasoline, for our purposes, are synonymous. *Benzole* should therefore read *Benzine.* (Authors' note.)

pure, and so on, until the final treatment, in which pure solvent—that is, solvent with the greatest extractive power—is employed, because the less extractable material that is available, the more difficult it is to extract, and the more powerful must be the extractive agent. In extraction industries, usually the extractable material and not the non-extractable residue is wanted, but the basic principle is the same as in the extraction methods used in the cleansing industry. In chemical industries, pure solvent is used in the final extraction, not from any altruistic or esthetic motives, but simply and solely because it is sound economy of time and materials.

In our opinion, a dry cleanser's continuous process working on this principle would be economical and just as effective as batch processes if done on a large scale, but would not be economical for the small cleansing establishment. As a matter of fact, the cleansers' batch processes more nearly approach the ideal continuous process. It is permissible for the batch cleansers to start the process with a slightly dirty solvent, especially solvent which has been used in the previous rinse, and to repeat the treatment with clean solvent until the liquid finally obtained from the cleansing machines is reasonably free from dissolved and suspended matter. The cleansers using the continuous process start with dirty solvent —all of our samples have been filthy— and keep on using filthy solvent. Usually, the only intentional purification the solvent receives is a brief and totally inadequate passage through high speed centrifuges.

A certain amount of solvent is lost by volatilization, by drying, and by spilling on the floor. This is replaced by fresh solvent, which is really the only way, so far as we have observed, by which the filthy condition of the solvent is materially improved. Naturally, the solvent soon reaches a state of filth which such dilution does not change appreciably. For example, to make the original solvent represented in Curve III comparable to that represented in Curve IV, dilution with eight parts of fresh naphtha to one of the original was required. In the plant from which the Curve III solution was taken, the dilution actually used probably does not exceed one part of fresh naphtha to twenty parts of dirty naphtha. This is another way of saying that the Curve III naphtha was eight times as dirty as the Curve IV naphtha; and the Curve IV naphtha was considered too dirty to be used by the manager of the plant from which it was taken. The Curve III naphtha was the best and cleanest naphtha in actual use by the firm from which it was obtained. Their fresh naphtha was reserved for dilution and for cleaning gloves, and at no stage of the process were garments treated with fresh, clean naphtha.

Cleaning Gloves

The methods used by some cleansers are brought out strikingly when the solvent used on gloves is compared with the solvent used on garments. Discoloration of dark garments is difficult for the customer to detect, because he does not retain a sample of the original material. With white or light kid gloves, the slight discolorations would be noticed; therefore, all cleansers use clean naphtha in the glove department, and as soon as the naphtha begins to show the characteristic yellowish-brown tint, it is passed on to the garment cleansers. No one at home would attempt to re-

move the spots from a garment with dark brown colored solvent, but that is precisely what a number of plants are doing today. The fact that colored solvent is prohibited by all cleansers in the glove department is mute testimony to their full knowledge of the dirt contained in solution or in suspension in such solvent.

Purification of Used Solvent

Numerous methods of purification were seen in operation; among these are the following, used alone or in various combinations: (*a*) clarifying, (*b*) filtering or treating with Darco, (*c*) settling, and (*d*) distilling.

Clarifying

Clarification has already been described, and it has been pointed out that this is usually the only method employed in the so-called continuous process plants for purifying dirty solvent. If the solvent contains a fair amount of dissolved materials such as grease and oils, its specific gravity increases. If equal amounts of used solvent from a well-conducted plant and from a plant using filthy solvent are centrifuged, the better grade of solvent will often show more suspended matter at the bottom of the centrifuge tube than will the filthy sample. If, however, one takes the filthy sample and dilutes it with fresh naphtha, thus lowering the viscosity, and then repeats the treatments in the centrifuge until he has used up the entire amount of the original dirty solvent, he will collect many times the amount of suspended matter obtained without the dilutions. The practical application of this in the dry cleansing industry is that the more viscous the solvent becomes, the harder it is to remove the suspended matter, and, therefore, the more ineffective the clarification becomes.

Filtering, or Treating with Darco

After clarifying, a number of plants subject the partially purified solvent to filtration through fuller's earth or to treatment with an adsorbent such as Darco. In either case, the ultimate object is to remove as much as possible of the coloring matter, suspended matter, and dissolved matter such as grease and oils. The fuller's earth treatment consists in passing the clarified solvent through beds of fuller's earth, which are fairly effective in filtering out suspended matter not caught by the clarifier and in removing a certain small proportion of the dissolved materials. Most plants throw away the fuller's earth and put in a new supply after 4,000 gallons of solvent have been treated. One unusually careful manager renewed the fuller's earth after 2,500 gallons of solvent had passed through.

Settling

Most plants have several tanks in which the solvent from the clarifiers is allowed to settle overnight. The comparatively clear, supernatant liquid is drawn off the next day for use in the cleansing machines. This is commendable, for even a few hours' settling will bring down substantial amounts of suspended matter, whether the solvent has been previously clarified or not. Settling would be particularly effective in the case of plants using dirty solvent if they would add fresh naphtha, thereby reducing the viscosity and accelerating the settling process.

Distilling

Whether all suspended matter has

previously been removed or not, solvent which has been distilled should be water-white and free from dissolved oils and greases. Clarification prior to distillation is advisable because less residue is left in the stills, which, therefore, do not have to be cleaned so often, and because the steam coils furnishing the heat for the distillation do not become coated so quickly.

If a garment is treated with dry cleansers' solvent, a certain portion of the natural waxes and oils, particularly in the case of wool, is probably removed. If the solvent containing these waxes and oils is then distilled, the waxes and oils remain in the still. Consequently, if the garment in question is returned to the cleanser a year or so later for another treatment, it will thereby be further impoverished in respect to these natural waxes and oils. It has been said that the use of adsorbents, for example, of Darco, obviates this difficulty.

Ventilation

Fire Risks

It is pointed out elsewhere in this paper that most liquids which are satisfactory for use in dry cleansing present serious fire hazards in both their liquid and their vapor phases. To this somewhat general rule, carbon tetrachloride is a notable exception. The common solvents used, naphtha and benzol, both give off appreciable amounts of vapor at room temperatures. When this vapor is mixed with the proper proportion of air, the mixture becomes inflammable and often explosive if the temperature or source of ignition is sufficiently high.

Contrary to popular belief, a glowing cigar or cigarette can be extinguished by naphtha (gasoline) or benzol. The temperature of the cigar or the cigarette is too low to ignite either the vapor or the liquid. The temperature of a lighted match, or any other open flame, however, is high enough to ignite either the liquid or the vapor. The passing of an electric spark is accompanied by a localized, but extremely high, temperature, more than sufficient to ignite gasoline or naphtha vapor in air.

In the dry cleansing industry, an important and well-recognized fire hazard lies in the danger from electric sparks in the cleansing machines. These sparks are due to static discharges from garments such as silks to garments charged with lower or opposite potentials or to the nearest "grounds."

The Effect of Atmospheric Humidity

It is well known that sparks from static electricity are more easily obtained in dry than in wet weather. This fact is recognized in the textile industries, where a relative humidity of at least 50 per cent. is maintained throughout the year to facilitate such operations as spinning. It is difficult to spin strong yarns in dry weather because the individual fibers do not twist and lie flat with the same readiness as when conditions are somewhat more humid.

In the dry cleansing business, the same reasoning applies. The agitation in naphtha of goods such as silks is an excellent method for the generation of static electricity, but if these goods or the atmosphere in which they are kept contain about 50 per cent. relative humidity, the static hazard is reduced, although the propagation of an explosion or a flame, if started, may be but little affected.

This applies with equal force to the

operations of cleansing, extracting, and drying. Well-equipped cleansers now install live steam outlets at convenient points in the cleansing and drying rooms to saturate the air in the event of a fire. Furthermore, modern mechanical driers are equipped with live steam outlets within the drier to add moisture to the hot dry air forced into the machine. Automatically controlled temperature and humidity conditions in the cleansing business are not maintained, however, although most cleansers admit that such conditions would be desirable.

Toxic Hazards

The vapors of solvents such as benzol are well recognized as distinct toxic hazards. The specific effect of inhaling benzol vapor over extended periods is injury to the blood-forming mechanism, and the subject soon falls into a state of anemia which may be of varying degrees of seriousness according to the duration of the exposure and the amount of actual benzol vapor breathed.

The best method of avoiding dangers from benzol fumes is to provide proper ventilation. In the case of very high concentrations, employees should wear gas masks, oxygen breathing apparatus or hose masks, which protect the subject even in an atmosphere saturated with benzol vapor. Industrial gas masks now on the market will protect against relatively slight amounts of benzol vapor (about 3 per cent.), but would be unreliable for more than a short time as protection against higher concentrations in tanks which had been used to store benzol.

Vapors from naphtha or gasoline are less specific and less harmful in their physiological effect. Some people are more prone to be affected than others. Usually the results are not serious because the subject has some sense of what is happening—of his physiological reactions—as he is breathing the air in question. The common effect is narcosis, with results not unlike alcoholic intoxication and disagreeable after-effects. It is not improbable that prolonged or chronic exposure would induce anemia.

It is our opinion that much too little is known about the fundamental difficulties in the dry cleansing industry. Practical standards of ventilation and air conditioning should be developed and should be based upon laboratory and field experiments. Such standards would do much to reduce the present markedly unscientific control method in use in both well-conducted and poorly conducted establishments.

Lighting

The lighting in most of the plants which we saw was fair. In the room set aside for spotting and pressing, the illumination should be the best in the plant. Usually the spotting and pressing are done directly beside windows, and on clear days the illumination is satisfactory. It is fortunate for the dry cleansing industry that the rush season occurs in the months which are warmest and in which there is also the greatest amount of daylight. Thus, sufficient light and ventilation for most of the operations can be obtained by opening windows. In large establishments doing considerable business in the winter months, we should imagine that better lighting in the spotting and pressing rooms would be a profitable improvement. Plenty of good light of a uniform type would then be available at

all times. This is far from being the case at the present time.

Tests to Determine Dirtiness of Solvents

We have found two outstanding indices of dirtiness in all the samples that we have examined—over seventy in number—from different plants in the vicinity of Boston. They are (*a*) color and (*b*) specific gravity. It is inevitable that the two go together.

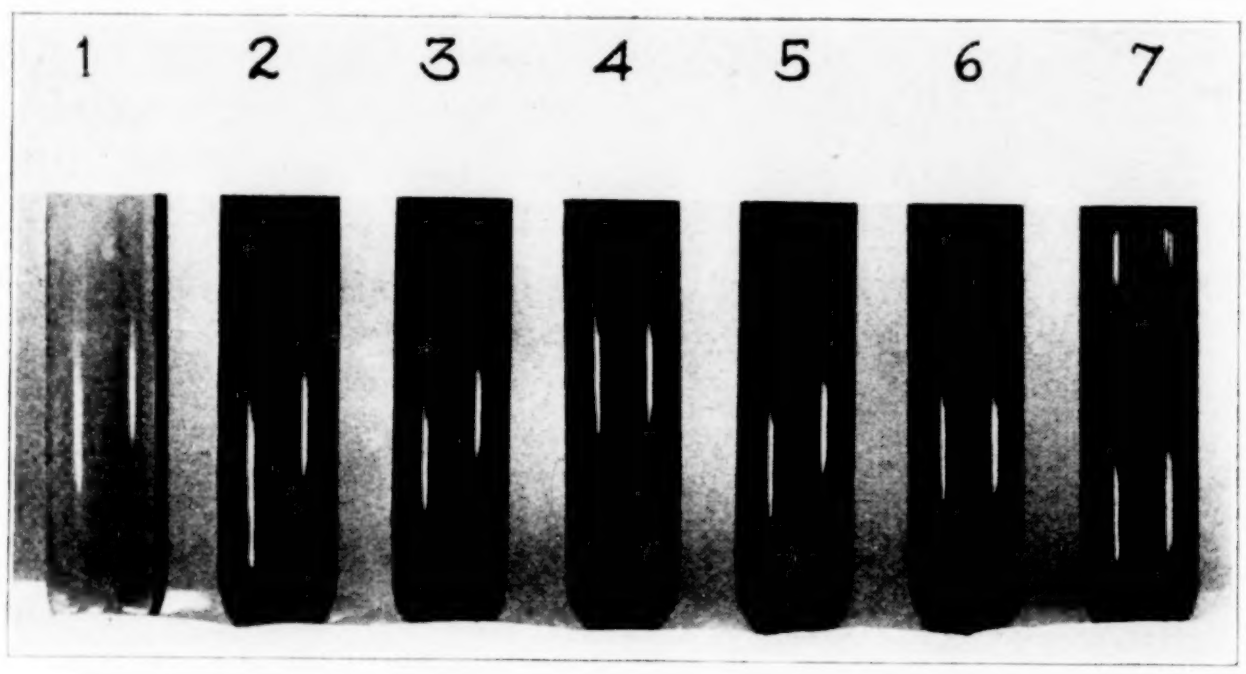

Fig. 2.—Color scale.

Color Scale

After it has been filtered or centrifuged in the laboratory, used solvent ranges in color from straw to a dense brownish black. One of the worst samples that we obtained was set aside as a standard, and a portion was centrifuged and treated with Darco to remove some dissolved matter. Seven glass tubes were then filled with portions of the dirty solvent plus fresh naphtha and sealed hermetically (see Fig. 2). In all but No. 1 (fresh naphtha alone), some material settled out after the dilution with fresh naphtha, so that the tubes must be shaken before they are used. Chemically, these various degrees of dirtiness have little significance, but the tubes are useful as standards with which to compare new samples.

It is amusing to note that the original solvent from which these tubes were prepared was twice as dirty as No. 7 and that it was solvent which had been treated chemically to remove dissolved material. For the color scale, the original was hopelessly dirty.

Samples to be tested are first filtered or centrifuged. Those which we consider satisfactory for use in the first wash are not above No. 3 in dirtiness. For the final rinse, No. 1 or better should be used. Solvent taken from the machines after the final rinse should not be dirtier than No. 2.

Decolorizing Test

Adsorption. — Charcoals are now available which are sufficiently powerful to decolorize by adsorptive action the filthiest naphtha samples we have obtained. Not only will such treatment decolorize the naphtha, but it will deodorize it as well. The possibility of using an adsorption test for the degree of dirtiness of the dry cleanser's naphtha lies in the fact that the decolorizing action is a function both of the time of treatment and of the amount of ad-

sorbent used. At a given temperature and in a given time, 0.5 gm. of fine kelp charcoal will decolorize 100 c.c. of Curve II naphtha and have but little effect on Curve III naphtha. To produce comparably clean solvent from Curve III naphtha, it is necessary to repeat the treatments a number of times, to use more charcoal, or to do both.

Kelp charcoal and charcoals of equal adsorptive power are expensive for the purpose of this test, while Darco has been shown by the Bureau of Standards (1) to be satisfactory. It is a fine black powder, and, when shaken with naphtha, settles slowly. By adding a small amount of trisodium phosphate solution, C. C. Hubbard at the Bureau of Standards found that the emulsified Darco settled out more rapidly. While it is unnecessary in this report to discuss the physical chemistry of the settling produced by trisodium phosphate, it is sufficient to say that the settling appears to be a function of the hydrogen ion concentration of the system Darco-solvent and that buffer solutions which are more alkaline than trisodium phosphate seem to give better results, whether dry cleansers' soap has been added or not.[5] After a number of tests, we finally adopted sodium carbonate solution. Among the other materials tried were water glass, ethyl alcohol, monosodium, disodium and potassium phosphates, caustic potash, and caustic soda—all dissolved in water. The sodium carbonate was found to be more satisfactory than trisodium phosphate; it is cheap and can be bought in any drug or grocery store. A 3 per cent. solution was used—that is, 3 gm. per 100 gm. of water, or 3 ounces per 100 ounces of water.

In Figure 3 is shown the apparatus used in this test. One hundred cubic centimeters of solvent are poured from a graduate into the bubbling flask (2), a small level teaspoonful (approximately 0.6 gm.) of Darco (5) and 5 c.c. of sodium carbonate (4) are added from

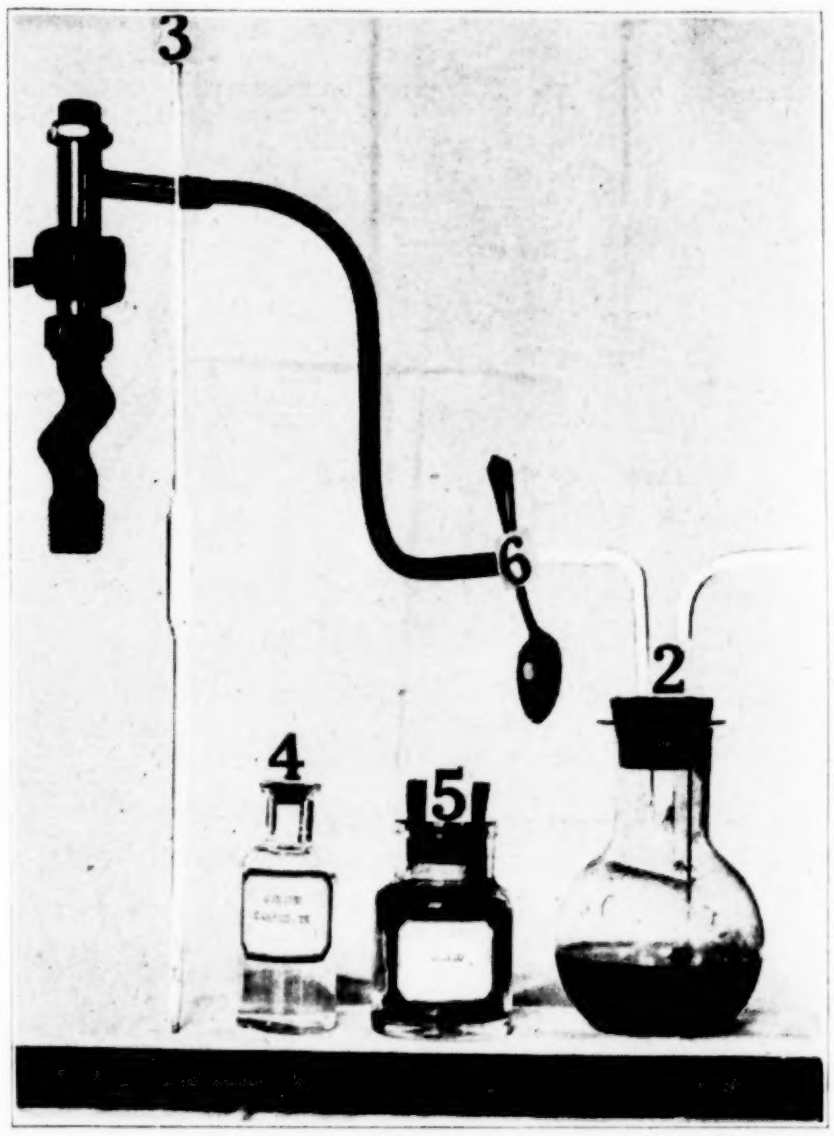

FIG. 3.—Apparatus used in decolorizing test.

the pipette (3), the stopper is placed in the bubbler, and air is drawn through for five minutes to agitate the Darco. It is advisable to have a uniform standard method of agitation, as the action of the Darco and the rate at which it settles are affected by the degree of agitation. When the solution was shaken by hand for five minutes, it was found unusual for two people to obtain similar results.[6] By using the aspirator

[5]The Darco Sales Corporation suggests that strong alkalis react with the "soaps" giving a true metallic soap, sodium oleate, which acts as a floc and promotes settling of suspended matter.

[6]Comparisons in the laboratory are best done in Nessler tubes or a colorimeter. These are probably unnecessary refinements for routine tests.

and bubblers, three or four samples can be run at the same time.

After agitation for five minutes the bubbler is disconnected, the black emulsion is allowed to settle for five minutes, and a portion is filtered through No. 5 Whatman filter paper. The filtrate should be colorless (water-white) and free from abnormal odors. The settling for five minutes is not essential and need be done only if the specific gravity of the treated material is to be taken.

This test will pass, by a comfortable margin, all naphtha which would pass the U. S. Army specifications and will probably not pass solvent from plants which do not use a final rinse in fresh solvent. All continuous process samples that we have received at this writing fail to pass the test, while samples such as Curve II naphtha pass with a comfortable margin. Curve II solvent would not pass the U. S. Army specific gravity test and would have to be diluted with fresh naphtha. The Darco test is, therefore, not unduly exacting and was designedly made to pass samples which we have shown repeatedly, by analysis and by cleansing tests on fabrics and gloves, to be in a perfectly proper state for the first wash in the cleansing process.

Specific Gravity Test

Fresh dry cleansers' naphtha has a specific gravity of about 0.75, and the benzol a specific gravity of about 0.87 to 0.88 at 60° F. Solvent containing dissolved material such as greases, oils, etc., will usually, but not always, increase in specific gravity. The common method of testing for specific gravity is to use hydrometers which float at definite heights in liquids of definite specific gravity. The liquid under test should be free from suspended matter and the temperature should be known since both suspended matter and temperature have an effect on specific gravity. Of the two, the effect of temperature is greater and much more important.

For a field test, sufficient accuracy can be obtained by allowing the solvent to settle for five minutes before hydrometer readings are taken. A single hydrometer reading from 0.7 to 0.8 is sufficient to measure the gravity of naphtha samples, while a hydrometer reading from 0.8 to 0.9 suffices for benzol samples.

At the start of the first wash and at the completion of the final rinse, regardless of the cleansing process used, the specific gravity of the naphtha should be not more than 0.757 (benzol 0.875) at 60° F.

For this test, the apparatus needed are:

(*a*) A thermometer and hydrometers reading 0.7 to 0.9 in specific gravity or the equivalent in Baumé.

(*b*) A 100 c.c. glass graduate.

(*c*) A filter funnel and package of filter papers.

Bactericidal Effects

Another important phase of our problem was to determine the effect of the dry cleansing process upon such types of bacteria as might be present on a garment when received at a dry cleanser's plant.

Review of the Literature

A few attempts have been made by other workers in the past to study the bactericidal effect of one or more phases of the dry cleansing process. Jackson (2) published data obtained when pieces

of sterile cloth inoculated with Bacillus subtilis were submitted to the "cleaning process." A comparison of the bacterial count before and after processing showed a marked decrease in the number of organisms in the test cloth at the end of the "run." The Gradwohl Laboratories (3) examined several samples of gasoline purchased on the open market but obtained no organisms when portions of these samples were tested in nutrient culture tubes. They state that exposure to gasoline for one hour would prevent the further growth of staphylococci and Bacillus typhosus. The New York Board of Health (4) is reported to have authorized the statement that such disease germs as those causing influenza, scarlet fever, colds, bronchitis, pneumonia, tuberculosis, diphtheria, measles, and typhus fever are killed by proper dry cleaning methods.

C. F. Meissner[7] of the Troy Laundry Machinery Company made the following comments: "It would be a mistake to assert that dry cleansed clothing is sterile. The removal of the dirt means the removal of a very large proportion of the germs. The germicidal properties of gasoline and other cleansing fluids were investigated and after a careful search through all publications on the subject, the conclusion was arrived at that neither gasoline, kerosene, carbon tetrachloride, nor benzol might be regarded as possessing any germicidal properties worth considering." He also added the following opinion concerning another phase of the cleaning process. "It is doubtful if the heat generated in the pressing process is enough to have any decided sterilizing effect. Of course, it will kill a great many of the germs, but, from the standpoint of the health officer, there is a great difference between having a garment sterile, and having a garment nearly sterile."

In this study it seemed advisable to conduct the experiments under controlled conditions in the laboratory rather than in a plant, where sterility of apparatus would be difficult to obtain. Moreover, we desired to prevent as far as possible the mechanical removal of bacteria, such as may occur in the cleaning process, and to confine our observations to the actual bactericidal phases of the process.

The organisms selected were of two general groups, spore-forming and non-spore-forming bacteria; the latter are relatively easily destroyed by heat or chemical agents, the former are much more resistant to physical and chemical action. Each type of organism was pathogenic and might produce an infection in man.

Outline of the Experiments

In Experiment 1, four types of fabric were employed in the tests—namely, silk, white flannel, and yellow and blue woolen material. Strips of each type of fabric measuring approximately 1 inch by ½ inch were wrapped in several thicknesses of cloth and sterilized in the autoclave for thirty minutes at 15 pounds steam pressure. Control examinations showed that each type of cloth was sterile after this treatment.

The following organisms were employed in this experiment: Staphylococcus pyogenes aureus, Streptococcus hemolyticus, Streptococcus viridans, and two strains of Bacillus anthracis. Each type of organism was grown in infusion broth containing 1 per cent. dextrose for forty-eight hours at 37° C.

[7] Letter of March 15, 1923 to Arthur P. Hall, President, New England Association of Dyers and Cleaners.

Then the pieces of sterile cloth, one of each kind, were immersed in the cultures of the several organisms. After about five minutes the inoculated cloth was removed from the culture and dried in sterile glass dishes in the incubator overnight. Tests were made of each type of cloth inoculated with each organism and in every case living bacteria were shown to be present.

In Experiment 2, the following organisms were used: a yeast culture, Staphylococcus pyogenes aureus, Streptococcus viridans, and one strain of Bacillus anthracis. The organisms were grown on dextrose infusion agar plates for forty-eight hours at 37°C. The growth was then scraped from the plates and applied to the strips of sterile cloth. The cloth used in Experiment 3 also was inoculated in the manner which has just been indicated.

The cleansing mixture with which the inoculated cloth was treated in Experiments 1 and 2 was made up according to the method recommended by a reputable dry cleansing establishment and consisted of 140 volumes of naphtha to 1 volume of soap solution. The soap solution was a mixture of oleic acid, ammonia, and naphtha. Fifty cubic centimeters of the naphtha containing soap solution in the above ratio were placed in 100 c.c. sterile bottles. The mixture was then tested for sterility, and in every instance cultures were sterile after forty-eight hours' incubation. One strip of each of the four kinds of cloth, which had been inoculated with one strain of organisms, was placed in a single bottle of the cleansing mixture. The contents of the bottle were then shaken for about thirty seconds and allowed to stand for twenty minutes. A similar series was allowed to stand for forty-five minutes instead of twenty minutes. The latter containers were shaken at the beginning and at the end of the first twenty-minute period. At the end of the periods of twenty and forty-five minutes, respectively, the pieces of cloth were removed aseptically and dried in sterile glass dishes in a hot air oven for ten minutes at a temperature of 140°F., in Experiment 1. In the second experiment, a temperature of 160°F. was employed for ten minutes. After drying, each strip of cloth was placed in a separate test tube containing dextrose infusion broth; the tubes were then incubated for forty-eight hours at 37°C. The results obtained in Experiment 1 showed that neither twenty minutes' nor forty-five minutes' exposure to the cleansing mixture, combined, subsequently, with ten minutes' drying at 140°F., was sufficient to destroy any type of organism tested. The kind of cloth on which they were inoculated had no evident effect.

In Experiment 2, as was described above, the test cloth was inoculated with the growth scraped from dextrose infusion agar plates. For all but one of the tests, the cleansing mixture was made the same as in Experiment 1. In the one exception mentioned, the concentration of soap solution was increased to five times that used in the other tests. Staphylococcus pyogenes aureus was the organism tested in this more concentrated mixture.

In spite of the more superficial inoculation of the cloth, the higher temperature used in drying out the odor of naphtha (160°F.), and, in one case, the use of five times the usual concentration of soap solution, each type of organism survived the maximum treatment, and no strain was completely killed by any modification which was tried.

Trousers and certain other garments are subjected to a pressing process after dry cleansing. This is usually carried out in a pressing machine with the aid of live steam. In order to test the bactericidal power of this process, strips of white flannel and blue woolen cloth were inoculated with Staphylococcus pyogenes aureus and Bacillus anthracis in the manner described for Experiment 2. These pieces of inoculated cloth were placed between two thicknesses of a sterile coarse linen towel. The manager of an excellent cleansing establishment kindly consented to operate the pressing machine, duplicating as nearly as possible the procedure which his company commonly used in pressing a pair of trousers. He stated that, in his opinion, the two thicknesses of towel were not sufficient to prevent the maximum action of the pressing process on the pieces of cloth to be tested. The total time during which the cloth was exposed to live steam in the pressing machine did not exceed sixty seconds. After the pressing, a strip of each specimen of cloth was introduced into a tube of dextrose infusion broth and incubated for forty-eight hours. The tubes were examined at the end of this period and were found to contain pure cultures of the two organisms used in the test. This experiment indicates that the pressing operation, carried out under as nearly trade conditions as possible, did not destroy the relatively easily killed staphylococci or the more resistant spore-forming anthrax bacilli.

Discussion

The results obtained in the experiments previously described might at first seem to be at variance with those obtained by other workers. In Jackson's (2) experiments pieces of inoculated fabric were attached to garments and bacterial counts were made after each step in the dry cleansing process. Efficiencies were computed on the basis of bacterial removal, and apply to the entire process, giving figures in keeping with hygienic standards. Jackson's results do not conflict with our findings which show that complete sterility would not be assured by the process. The mechanical cleansing effect obtained by the entire process is not questioned by us and on this Jackson bases his conclusions. Almost any solution, even water, would mechanically rinse out—not destroy—many bacteria from a piece of cloth which was processed as he described. In view of this fact, a determination of the number of living bacteria in the various solutions which had been in contact with the inoculated pieces of cloth would have been a very important control. Unless it can be clearly demonstrated that the organisms are actually killed, not mechanically removed, during the test, one is not justified in concluding that they have been destroyed. Assuming that the percentage efficiency which Jackson reports is correct, it should be noted that at the end of the process, in Plant 1, for example, 40,000 organisms and 500 organisms in the first and second series, respectively, were present on each square inch of cloth. Bacterial counts on garments which have been dry cleansed, dried, and pressed would probably be far lower than those resulting from Jackson's conditions, which he intentionally made severe.

The gasoline which we used was sterile as obtained from the trade, and this agrees with the findings published by the Gradwohl Laboratories (3). Their article, likewise, lacks detail, but they conclude that the exposure to gasoline

for one hour would prevent the further growth of staphylococci and Bacillus typhosus. Our findings show quite conclusively that staphylococci are not killed by exposure for forty-five minutes to the naphtha-soap solution mixture.

Since the organisms causing influenza, scarlet fever, colds, measles, and typhus fever are not definitely known, it is relatively quite difficult to experiment with such diseases. It would be extremely laborious to collect sufficient data to justify such a statement as that credited to the New York Board of Health (4).

The opinions expressed by an official of one of the laundry machinery companies seem to be entirely in accord with the data which we obtained.

Conclusions

Exposure for a twenty-minute or a forty-five minute period to an ordinary dry cleansing mixture was not sufficient to destroy completely any of several representative types of organisms. Subsequent drying of the inoculated cloth at 140° F., and at 160° F., for ten minutes likewise failed to destroy the organisms, as did also the addition of five times the usual concentration of soap solution to the cleansing fluid under identical conditions of processing and drying.

Exposure of anthrax bacilli and staphylococci to live steam in a pressing machine, for the time commonly used in pressing trousers, did not kill these organisms.

It would seem that the dry cleansing process as carried out in the better operated plants does undoubtedly remove mechanically many bacteria from the garments treated. While it would be very desirable from an esthetic standpoint, at least, to kill all the bacteria in the garments which are dry cleansed, the failure to do this has not, so far as we are aware, proved to be a serious menace to public health.

Summary

Extracts from a report of an investigation of the dry cleansing industry in the vicinity of Boston show that numerous establishments are using extremely dirty cleansing solvents and utilize neither stills nor adsorbent treatment to improve the cleanliness of the used solvents. Standards of cleanliness of solvents are proposed, and simple tests designed for use in the field are suggested. Ventilation is discussed from the standpoints of health and fire hazards. The bactericidal effects of the dry cleansing process were found to be negligible, but it is believed that the mechanical effects of the process in removing bacteria are good.

BIBLIOGRAPHY

1. Hubbard, C. C., and Heinze, H. A.: Complete Report on Purification of Dry Cleaning Solvent. U. S. Bur. Standards. Report No. 5, Feb., 1924.
2. Jackson, L. E.: The Bacterial Action of Dry Cleaning. Am. Jour. Pub. Health, 1922, *12*, 507.
3. Communication from Gradwohl Laboratories. Nat. Assn. Dyers and Cleaners Rev., May, 1923, p. 33.
4. Hubbard, C. C.: The Prevention of Disease and the Carrying of Germs in Soiled Garments. *Ibid.*, March, 1924, p. 8. (Radio talk which includes statement from N. Y. Board of Health.)

AN EPIDEMIC OF LEAD POISONING CAUSED BY THE SANDPAPERING OF AUTOMOBILE BODIES*

ARCHIBALD S. DEAN, M.D., Dr. P. H.
370 Seventh Avenue, New York City

IN the summer of 1922 an epidemic of lead poisoning occurred in Detroit, the world center for the manufacture of automobiles. The majority of the men who were poisoned had been employed by a body manufacturing company which will be designated as Company "A." The unusual number of cases of lead poisoning at the Receiving Hospital was brought to the attention of the Detroit Department of Health, which undertook an investigation of the factories of Company "A" and of seven other large automobile or body corporations for the purpose of learning the methods of finishing automobile bodies.

THE EXTENT OF LEAD POISONING IN THE DETROIT REGION

A canvass was made of the Detroit hospitals to determine the total number of hospital cases of lead poisoning. One hundred and eight cases were reported. At the Receiving Hospital there were ninety-four cases in the period May, 1921, to February, 1924, inclusive. At the Harper Hospital there were nine cases in the period April, 1917, to April, 1922. At the Henry Ford Hospital there were five cases in the period January, 1917, to April, 1921.

The occupations of these 108 patients, as given in the hospital records, were as follows:

Occupation	*Number of Patients*
Sander at body company "A"	67
Other automobile factory workers	23[1]
House painter	7
Enameler with spray	2[2]
White lead factory worker	2
Paint factory worker	1
Other factory employees	3
Unknown	3

[1] Fourteen unspecified automobile or body factory workersr five painters, including two stated to have used spray; and fou sanders.

[2] Females aged 16 and 17 years.

The sixty-seven men who had been employed by Company "A" to rub with dry sandpaper the undercoats of paint on automobile bodies entered the Receiving Hospital from May, 1921, to February, 1924, and comprised the majority of all the Detroit hospital cases of lead poisoning. Eleven of the sixty-seven admissions were in June, 1922, and forty-five, or 67 per cent., were in the year 1922.

THE SYMPTOMS AND SIGNS OF LEAD POISONING

The Receiving Hospital's history data for the first thirty-eight Company "A" sanders, who were admitted from May 14, 1921, to August 7, 1922, were analyzed (see Tables 1, 2, and 3). Thirteen of the men were white and twenty-five were colored. Only one of the white men had been born in the United States. Six of the men had been employed by

*Received for publication May 14, 1924.

Company "A" for three weeks or less. Twenty-four were entered at the Receiving Hospital within eight weeks of the date of their employment.

men was 67 per cent. and for the white men, 77 per cent. The men's ages, which ranged from 15 to 53 years, averaged 30 years. In eleven of the

TABLE I.—THE SYMPTOMS AND SIGNS OF LEAD POISONING IN THE FIRST THIRTY-EIGHT COMPANY "A" SANDERS ADMITTED TO THE RECEIVING HOSPITAL

SYMPTOMS AND SIGNS	WHITE (13)	COLORED (25)	TOTAL 38	
			NUMBER	PER CENT. OF NUMBER REPORTING[1]
Colic	11	23	34	89.5
Stippling of red blood cells	13	17	30	79.0
Line on gum	9	20	29	76.4
Constipation	8	16	24	63.2
Weakness	8	3	11	29.0
Nausea and vomiting	4	5	9	23.7
Rheumatic pains	1	4	5	13.2
Tremor of tongue	..	4	4	10.5
Perverted taste	..	4	4	10.5
Headache	1	3	4	10.5
Wrist drop	..	3	3	7.9
Icterus	..	3	3	7.9
Albuminuria	1	2	3	7.9
Hemoglobin (Tallqvist) 80% or less (7 white and 16 colored reported)	7	15	22	*95.6*
Color index under 1.00 (5 white and 15 colored reported)	2	11	13	*65.0*
Systolic pressure of 15 mm. or over more than Life Extension Institute standard. (10 white and 17 colored reported)	3	8	11	*40.7*
Systolic pressure of 15 mm. or over less than Life Extension Institute standard. (10 white and 17 colored reported)	1	1	2	*7.4*
Pulse pressure 55 or over (10 white and 17 colored reported)	2	6	8	*29.7*
Pulse pressure under 30 (10 white and 17 colored reported)	..	1	1	*3.7*

[1] When the number reporting was less than thirty-eight the percentages are italicized.

Colic was the major complaint in almost 90 per cent. of the men in the hospital. Constipation was marked in 63 per cent. of the cases. A line on the gum, known as Burtonian, blue, or lead line, was observed in the mouths of three-fourths of the men. Stippling of the red blood cells, which was reported for all the white men, would probably have been found in more than 79 per cent. of the white and colored together if blood smears had been secured from all the colored men.

The hemoglobin, which, by the Tallqvist scale, ranged from 40 to 90 per cent., averaged 70 per cent. The average hemoglobin value for the colored

twenty-seven sanders examined the systolic blood pressures were 15 mm., or over, greater than the Life Extension Institute standard (1) for the age of each man.

The average length of confinement to the Receiving Hospital was two weeks. A colored man, aged 53, who had been exposed to lead four or five years previous to employment by Company "A," died at the Receiving Hospital.

The Finishing of Automobile Bodies

Conditions at Company "A" Factories.—Trips were made to the Company "A" factories to determine the cause

of lead poisoning and to other plants to learn the methods which resulted in few hospital cases of lead poisoning. At the two Company "A" factories the dry sandpaper method was employed for the finishing of automobile bodies. A coupé body of steel with a wooden frame received four or five coats of paint. Coats one and two, called respectively a "priming coat" and a "lead spray," were applied as spray under air pressure, with the body in an alcove from which the air was drawn by a fan. The third coat, which was designated a "putty glaze," was put on with a broad putty knife. Samples of the paints which were used for the first three coats were analyzed in the chemical laboratory of the Detroit Department of Health, and all were found to contain lead. The bodies were dried between coats in ovens at a temperature of 150°F. After the third coat, or putty glaze, was dry, workmen known as "sanders" rubbed the coat with dry sandpaper to produce a smooth surface for the color-varnish, which was applied in small streams of liquid with a hose. The sandpapering of the putty glaze was done as successive coupé bodies moved along on a track between two rows of men. Each man rubbed a section of the surface as an automobile body passed in front of him. In one Company "A" building, where a majority of the thirty-eight men at the Receiving Hospital had worked, there was a long hood, the width of an automobile body, above the bodies. This hood was connected with air exhaust pipes. The heavy lead dust which was produced by the sandpapering of the paint was drawn upward past the men's faces. At the second Company "A" factory there was no artificial ventilation.

TABLE 2.—THE ASSOCIATION OF COLIC, STIPPLING, LINE ON GUMS, AND CONSTIPATION FOR THE FIRST THIRTY-EIGHT COMPANY "A" SANDERS

38 MEN		COLIC		NO COLIC	
		CONSTIPATION	NO CONSTIPATION	CONSTIPATION	NO CONSTIPATION
LINE ON GUMS	STIPPLING	15	4	1	2
	NO STIPPLING	2	4	..	1
NO LINE ON GUMS	STIPPLING	6	2	..	..
	NO STIPPLING	..	1	..	..

The men did not wear respirators, but most of them had about three thicknesses of cheesecloth tied around their heads so as to cover, or partially cover, their nostrils and mouths. A few of the men had a wet sponge 1 inch thick between the cheesecloth and the nostrils. New cheesecloth was supplied to the men every day or two by the company. The statement was made on two occasions by the industrial engineer that the cheesecloth, which was used principally by the sanders, cost the company $1,200 a month! The sponges were supplied by the sanders themselves and were washed by them once or twice a day. The industrial engineer

TABLE 3.—ASSOCIATION FREQUENCY FOR THE FOUR COMMONEST SYMPTOMS AND SIGNS OF LEAD POISONING

ASSOCIATION	NUMBER OF CASES	PER CENT. OF 38
Colic and stippling of red blood cells	27	71.1
Colic and line on gums	25	65.8
Colic and constipation	23	60.6
Colic, stippling of red blood cells, line on gums, and constipation	15	39.5

said that the men would not wear the respirators which the company furnished.

A piece of cheesecloth which was obtained from the industrial engineer of Company "A" after it had been worn for one workday by a sander was found, at the chemical laboratory of the Detroit Department of Health, to contain 81 mg. of metallic lead. Seventy-four to 106 mg. of lead would be inhaled in eight and one-half hours by a man who breathed 0.45 cubic meter per hour of air containing the amounts of lead found by G. E. Duckering in workrooms where motor car bodies were sandpapered (2). Sir Kenneth Goadby (3) states that: "Any factory air which shows that men exposed to it would inhale more than 2 mg. [of lead] per day must be considered as highly dangerous." Dr. L. Teleky of Vienna concludes that a daily dose of 10 mg. might lead to severe symptoms of lead poisoning in a few weeks (2). The amount of lead in the air at the Company "A" plants was sufficient to account for the cases of lead poisoning.

The Company "A" sanders had little opportunity to keep clean. The clothes which were not being worn by the workmen hung on open racks in the rooms where the sandpapering was producing lead dust. There was an inadequate supply of wash bowls for the sanders and the other men at the body factories. Six sets of hot and cold water faucets were found for about 300 men—an average of one set for each fifty men. The period for lunch during the night shift of eight and one-half hours was fifteen minutes and during the day shift of eight or nine hours was thirty minutes. The men could not wash and eat in the time allowed for the lunch.

More sanders poisoned by lead would very likely have entered the Receiving Hospital if the labor turnover rate at the Company "A" factories had not been very high. About 2,000 men were hired in a year to keep 200 sanders on the job, which utilized 100 men on the day shift and another 100 men on the night shift, according to an estimate by the company's industrial engineer. In some months 200 men were hired. The yearly labor turnover was 1,000 per cent. The mean duration of employment was, therefore, approximately five weeks.

Company "A" began to manufacture automobile bodies early in 1920. At that time it employed about 1,400 men. From December, 1920, to May, 1921, the plants were operated intermittently because of a depression in the automobile industry. A rapid expansion followed, so that in 1922 approximately 10,000 men were employed, of whom about 200 were sanders.

A waterproof sandpaper which permitted water to be applied to the lead painted body by means of a sponge was substituted for dry sandpaper in April, 1923. During the eleven months from April 1, 1923, to March 1, 1924, only five men from Company "A" were admitted to the Receiving Hospital as a result of lead poisoning.

Conditions in the Detroit Region at Other Companies than "A."—The conditions in the Detroit region at other companies than "A" were investigated for purposes of comparison. The only company in the Detroit region other than "A" which employed the dry sandpaper method for the finishing of bodies had ventilating equipment which provided a strong draft from a large intake pipe near the ceiling downward through the openwork floor of the long, narrow room in which the dry sand-

papering was done. No hospital cases of lead poisoning were reported among the sanders of this very large company. The *upward* draft at the Company "A" factory apparently should have been a *downward* draft to have lessened the inhalation of the heavy lead dust.

With the exception of Company "A" and the one other company which produced the same make of automobile body, automobile and body companies in Detroit used pumice stone and water instead of sandpaper on body surfaces. When the surface was to be smoothed with pumice and water, no coat of finish was put on with a putty knife; they were applied thinly as a spray, in small streams, or, rarely, by brush. The number of coats reached thirty for a very fine job.

The pumice stone and water method is more expensive than the sandpaper process. It causes little dust except from material which may fall to the bench or floor and dry. The painted wooden wheels and the lead putty in the holes on the bodies are generally sandpapered.

At one Detroit automobile factory all-metal bodies were not finished by immediate hand labor, but were suspended from conveyors and passed alternately through tanks of enamel and through ovens, at temperatures of about 300°F. This process lasted approximately four hours. The equipment was extensive.

Conditions Outside the Detroit Region.—In Ohio the chief cause of the cases of lead poisoning which were reported to the State Department of Health during 1922 was the sanding of automobile bodies at one large establishment. This company, which notified the State Department of Health of 104 cases of lead poisoning, adopted, before the end of 1922, a waterproof sandpaper which was used with water. On May 21, 1923, no cases of lead poisoning had been reported by this company for the year 1923 (4).

In England the Daimler Motor Car Company, Ltd., and the Sunbeam Motor Company, Ltd., successfully use only leadless paints. In January, 1920, a British committee appointed to investigate the danger attendant on the use of lead compounds recommended to the Secretary of State for the Home Department the prohibition in coach and automobile body building works after three years from the date of report of the use of any paint, filling, stopping, or similar material which contains more than 5 per cent. of its dry weight of a soluble lead compound (2).

Summary

Sixty-seven men who had sandpapered the undercoats of lead paint on automobile bodies for one company entered the Detroit Receiving Hospital poisoned by lead. Eleven of the admittances were in June, 1922, and forty-five, or 67 per cent., of the sixty-seven, were in the year 1922. These sixty-seven patients constituted the majority of all Detroit hospital cases of lead poisoning.

The hospital history data for the first thirty-eight men were analyzed. Thirteen of the men were white and twenty-five were colored. Six of the men were entered at the hospital within three weeks of the date of their employment as sanders and twenty-four were admitted within eight weeks.

Colic, which occurred in 90 per cent. of the thirty-eight men, was the principal complaint. Constipation was marked in 63 per cent. of the cases.

Hemoglobin values were low.

About 2,000 men were hired in a year to keep 100 men on the day shift sandpapering and another 100 men on the night shift.

The inhalation of lead dust formed by the use of dry sandpaper on lead paint poisoned the men. There was no downward draft to remove the heavy lead dust. The upward draft was ineffective. A piece of cheesecloth which was worn across the nostrils and mouth for one workday by a sander was found to contain 81 mg. of lead. The epidemic emphasizes the danger of lead dust inhalation.

The investigation of this epidemic of lead poisoning was guided by Dr. F. M. Meader, Director of Medical Service for the Detroit Municipal Department of Health. Dr. W. D. Mayer and Dr. Douglass Donald attended the patients at the Receiving Hospital and assisted in inspecting a Company "A" factory. The thesis was submitted to Dr. A. W. Freeman and to the Advisory Board of the School of Hygiene and Public Health of the Johns Hopkins University in conformity with the requirements for the degree of Doctor of Public Health.

BIBLIOGRAPHY

1. Newman, B. J., McConnell, W. J., Spencer, O. M., and Phillips, F. M.: Lead Poisoning in the Pottery Trades. U. S. Pub. Health Ser., Bull. No. 116, 1921, p. 95.
2. Great Britain Home Department: Report of the Departmental Committee Appointed to Investigate the Danger Attendant on the Use of Lead Compounds in the Painting, Enameling, and Varnishing of Coaches and Carriages. London, H. M. Stationery Office, Cmd. 630, 1920 pp. 30, 34, 37, 41.
3. Goadby, K.: Lead Poisoning in Industry. Jour. State Med., 1922, *30*, 111.
4. Hayhurst, E. R.: Letters of January 2, January 25, and May 21, 1923, to A. S. Dean.

INDUSTRIAL PSYCHIATRY*

HENRY B. ELKIND, M.D.
Boston, Mass.

THE past ten or fifteen years have witnessed the advent and growth of industrial medicine and hygiene in this country. Factory and department store are now considered incompletely organized if they are without a health department. While many of these departments have nurses in charge, there are many which employ also part-time physicians. There is also a small group of industries and stores having health departments which are more completely organized, with specially trained physicians who give full time to their work. Factory medical practice is devoted chiefly to the care and treatment of accidents, routine physical examinations being an important part of the work. Department store medical practice is mainly concerned with the care and treatment of illness. Accidents are not common, and injuries, when they occur, are generally of a minor character. Routine physical examinations are not yet as commonly made a required procedure as in factory practice. It has become apparent to men working in both fields, but especially to those in department store work, that a psychiatric approach to the solution of their medical problems is quite necessary. They see day in and day out cases of illness and disability where no organic basis for the complaints can be found. They have begun to realize also that mental factors and mechanisms complicate their insurance or compensation cases and tend to prolong the convalescence of many who are forced to give up work because of illness or accident. Dershimer (1) (2), Stevens (3), and others have recognized this and write that they consider that the recognition, the prevention, and the treatment of cases with mental complications are important and necessary parts of the work of industrial physicians.

A psychiatric approach means that the physician considers his patient as a personality. A proper evaluation of this personality and its disease or disability can best be made by considering the mental, physical, and social factors involved. Man, to be sure, is a physical organism; at the same time he is possessed of a mind. It is not necessary to consider here the question whether mind and body are one or separate; this is best left to metaphysical speculation. The attitude of modern science and medicine in this matter is that body and mind are one, and that each is a manifestation of the activities of the individual but viewed from different aspects. It is known that the functions of the one affect the functions of the other; that they are interdependent. In fact, many scientists and physicians consider that mind is the expression of all bodily function and epitomizes all the physiological activities of man.

Man is also a gregarious animal and is dependent for a satisfying and normal existence upon the presence of others of his kind. With these concepts clearly in mind it is easy to see that there may be physical, mental, and so-

*Received for publication May 2, 1924.

cial diseases, though one must remember all the while that these are more or less artificial classifications. Even in those diseases ordinarily known as physical there are mental components; on the other hand, physical factors are found in mental and social diseases. From a study of physical disease it has been found that certain well-defined laws govern its genesis and its development. The same is true of mental and social diseases although in these they are not so well known. The scope of this article does not allow further discussion of psychiatric method; but the foregoing remarks are included to indicate briefly what is meant by a psychiatric approach. The technic used demands special training and experience.

In a previous communication (4) it was pointed out that functional nervous disease is commonly encountered in industrial and mercantile practice. Functional nervous disease includes the psychoneuroses—such as hysteria, psychasthenia, and neurasthenia—and many forms of the neuroses. The so-called occupational neuroses are now and then encountered. The latter many times have some neurological involvement and may not be of a purely functional type. The others are of a decidedly functional nature. They depend a great deal for their development upon the personality of the individual and upon some special circumstance or set of circumstances which precipitate the illness. These are varied in character and too numerous to mention here. The more serious functional psychoses — schizophrenia and manic-depressive psychosis—are occasionally seen.

The term, "nervous disease functional," is one occasionally seen in industrial morbidity statistics. It is apparent that into this class are thrown all cases of mental disorder that are detected, except possibly the frank psychoses. The busy industrial physician is not able to differentiate the various types and finds in "nervous disease functional" a convenient label under which to classify them. It must be recognized, however, that all forms of mental disorder may be found in industrial medical practice; and that treatment and prognosis depend a great deal upon exact diagnosis.

There is a group of cases—becoming of greater importance as more attention is paid to their detection—which show slight deviations from the normal but which are difficult to classify as any particular form of frank mental disorder. Worry, suspicion, feelings of inferiority, hypersensitiveness, fear, and abnormal moodiness are symptoms encountered which disturb the patients greatly, interfere with their adjustments, and make life miserable, but which, fortunately, are capable of being removed by psychotherapy. These types are not generally classified under mental disorder as ordinarily understood but need to be recognized and treated early in order to prevent possible development into definite mental disease. This type of functional disorder, also, has been included under the term "nervous disease functional."

While functional mental disorder is the most common form encountered in industrial and mercantile practice, the industrial psychiatrist not infrequently comes in contact with cases where the etiology is mainly organic. The epilepsies (excluding those forms due to psychogenic causes), mental deficiency, and the alcoholic psychoses are the types most commonly met with. While syphilis now and then may be the cause of

the first two and may complicate the last, as an etiological factor it is more frequently found in general paresis, tabes, and the syphilitic psychoses. Among the rarer forms of mental disorder with an organic basis there are the senile and arteriosclerotic psychoses, and those due to brain tumor or disease.

These various disorders—functional and organic—are found in both factory and department store; but in those industries where dangerous chemicals and substances are used, special types of mental disorder may be met with. In this country these disorders have not generally been detected, with the possible exception of those due to mercury and lead. Even in the case of these poisons it may be questioned whether the presence of mental symptoms in connection with them has always been recognized. This may be partly explained when one realizes that changes in character, moodiness, alterations in attitude, and minor deviations from the normal have not been considered as mental disorders by many medical men. The average physician, because of lack of psychiatric training, has been led to feel that a psychosis or mental disorder exists only when the patient is stark or raving mad. This is, of course, not the case. With increasing interest in psychiatry and better opportunity for psychiatric training for medical students it seems highly probable that in the next ten or fifteen years the case incidence of psychoses and the minor mental diseases due to industrial poisons will increase because of more efficient and intelligent reporting. The detection of changes in character, of alterations of mood, of deteriorations in intelligence, or of other mental defects is very important from the point of view of compensation and responsibility. It is, moreover, evident that permanent mental disability of the character just described is oftentimes more serious and more damaging than many of the accidents and somatic illnesses that befall our workers. Changes in the mental status of disabled employees may affect their whole life, their relations with their family and with their community. In fact, they are known to have disrupted families and to have made unhappy, misunderstood individuals dependent upon public or private charity.

Industrial psychiatry has an important place in the work of industrial or occupational clinics connected with the outpatient departments of the larger hospitals. Intensive study of industrial disease is more convenient here than elsewhere. It will be worth while to arrange that special emphasis and concentration be directed toward the psychiatric aspect of industrial medicine. Up to the present time there is very little in the literature which would enlighten anyone interested in this phase of industrial medicine. Study even of the case records of many hospitals is apt to mislead one and give the impression that mental complications hardly exist. Once special attention is given to the psychiatric phase, the extent and the seriousness of the mental complications will be better understood than they are at the present time.

Industrial psychiatry also deserves an important place in the study, care, and treatment of disease or disability coming under workmen's compensation acts where there is legal controversy as to responsibility or as to severity. Many of these cases, even of a frankly physical nature, are frequently complicated or aggravated by mental factors, the recognition of which very often

tends to effect a cure or to shorten a protracted convalescence.

Industrial psychiatry should be considered as a specialized type of industrial medicine. Its practice should be limited to physicians who have grounded themselves in the principles and the technic of general psychiatry. It broadens the attitude of the physician in the recognition and treatment of the diseases of his patients whom he tends to study in the light of the broad conception of personality which is so strongly stressed in psychiatry. He analyzes the situation and the disease or defect into mental, physical, and social factors. Having done this, he is better able to prescribe treatment and to suggest changes in the adaptation of the patient to his environment. He will find that his patients will come to possess not only better physical health but mental health which taken together mean happiness, the goal of men's lives.

In a previous communication (4), mental hygiene in industry and personnel administration were classified as synonymous terms. Industrial psychiatry should not be confounded with either, although there are many opportunities for both to help in the solution of some of the industrial problems which arise in everyday experience. Mental hygiene in industry, or personnel administration, concerns itself primarily with the preservation of the physical and mental health of the employee and not with the detection and treatment of his ills. This does not mean that it does not concern itself with the importance of the latter, for this is impossible in a practical workaday world. It is necessary for the industrial clinic to care for emergencies, accidents, and minor ills but it is far more important that the activities of these clinics and their staffs be directed toward the preservation of health, both mental and physical. Personnel administration strives to maintain the well-being of the employee on psychological and economic grounds. It recognizes that, in the present industrial world, industrial and economic adjustments which are stable and satisfying are essential to the hygiene of a large percentage of our population. Tead and Metcalf in their book on "Personnel Administration" (5) define their subject as "the direction and coordination of the human relations of any organization with a view to getting the maximum necessary production with a minimum of effort and friction and with proper regard for the genuine well-being of the workers." This definition (by non-medical authorities) is interesting in that it emphasizes the preservation of the health of workers, which is in line with the prime purpose of hygiene as conceived today by leaders in the public health movement. Although the concept of adjustment or adaptation of man to his industrial environment is not clearly stated, it is implied in the definition. These authors stress the professional character of their work and apparently feel that the most successful and lasting adjustment for the worker is one which proves valuable to the community, to industry, and to the worker himself.

To illustrate the value of a knowledge of psychiatry in industrial medical practice the following three cases are cited and commented upon. They are examples of types of cases commonly encountered in industrial and mercantile medical practice.

CASE 1.—Mrs. R. B., a comptometer operator, aged 22 years, was referred to the health department because of headaches which were interfering seriously with her

work. Up to the time she was examined by a psychiatrist, she had been frequenting the health department on an average of three times a week for tablets to relieve her headache. About a year ago she had been referred to an excellent general hospital which diagnosed her condition as migraine. She received no benefit and her headaches grew worse. Summarizing her case, the important facts are these: Her headaches, frontal in type, began at the age of 12. She never experienced any of the typical migraine figures and very rarely suffered nausea. Three years ago she was married but separated from her husband two or three months later, after which her headaches became worse. She and her husband are both Catholics and divorce is practically out of the question. She would like very much to live with her husband if he were a different kind of man. It seems that her headaches commenced in the following way: Her mother suffers considerably from headaches and receives a great deal of sympathy from a large family and from her husband (the father) when suffering from one. Our patient admitted that she imitated this tendency in her mother in order to receive sympathy herself, and that she is the pet of the family and receives considerable sympathy from them. She recognizes the same tendency to this conduct when she is in the store, especially when thoughts of her husband and of her difficulties with him come to mind. She is in excellent bodily health as disclosed by physical examination. She wears glasses because of astigmatism and apparently obtains relief from them. She was advised to be examined again by an oculist to see if her glasses were correcting the defect sufficiently. It was explained to her that the headache was chiefly psychogenic in character but was centered about a slight organic condition which involved her eyes. (Periorganic symptoms are very common in functional nervous diseases.) Following this simple form of psychotherapy the patient reported at the end of six weeks that she had had only one severe headache and two "light pressures" on her head, and that she felt very much better and happier. (Her glasses were not changed.)

This case illustrates how an individual who was on the point of being discharged because of frequent absences due to headaches was reclaimed and made efficient in her work. This adjustment, of course, resulted in her becoming again satisfactory to the management.

Case 2.—Mrs. O. B., a salesgirl, aged 29, was diagnosed as suffering from "melancholia" by a physician connected with a department store and was referred to a psychiatrist for examination. Examination disclosed the following important facts. She was married ten years ago and her husband died eight years later from "high blood pressure" at the age of 38. He lingered in a paralyzed condition one year before death. Three years after marriage there had been one stillbirth. There have been no miscarriages nor children. Since her husband's death she has been very nervous and has suffered from rather frequent occipital headaches which have tended to become worse. She was very happy in her married life and has never been able to forget her husband since his death. It was with great effort that she banished him from her thoughts when she was at work. Just as soon as she left the store, she was again thinking of him; and she enjoyed taking long walks alone, ruminating and living over the experiences of her married life. She preferred to be alone, and avoided company, especially that of men. She enjoyed no amusements and avoided all places which she and her husband used to frequent. For this reason she did not go to church. When she ate in a restaurant she kept a vacant chair beside her for her husband. Life was black and there was nothing for her to live for. She promised her only girl friend that she would not commit suicide. She is working at the present time to pay up her husband's debts, which amount to a fairly large sum, and she has hinted that when these are paid her life will be at an end. She dreams frequently, always of her husband. She admitted that she was very much babied and petted by him, and it is quite apparent that she has been trying to live over this relation again. She continued to wear deep mourning both in the store and on the street for more than two years after her husband died and resented very much the suggestion that it might be to her advantage to wear a little color. During examination she was tearful, and at times was explosive in her answers; a few times she started to leave. She refused a complete physical examination. Her pupils were found equal and active but slightly contracted, and her knee jerks equal but sluggish. She appears somewhat obese and has a rather awkward carriage.

After the main facts were obtained, numerous suggestions along the lines of psychotherapy were offered to the patient which she persistently refused to accept. She did not wish to get well, and said that life on earth is short and that she would resist any attempt to lengthen her stay. She replied to the suggestion that she read certain literature that she preferred to read poems of sadness and stories of sorrow. She could not see how a change in her manner of life or her way of thinking would be of assistance to her.

After considerable questioning, the patient responded effectively to the suggestion that it would probably be desirable for her to devote some of her time to the care of others, especially young children. With considerable display of emotion and agitation she said that this alone would appeal to her and might make her life on earth more bearable; that her work at the store and her life at home were not satisfying and that an opportunity to be of service to others might fill the void in her life. Along these lines further psychotherapy was instituted and another consultation was arranged. The patient was also given a copy of Jackson and Salisbury's "Outwitting our Nerves" (6) to read in the meantime. It was not thought wise to ask for a Wassermann test until the patient was of a different frame of mind and was willing to co-operate.

She was seen again about six weeks later, when a remarkable change in her appearance and manner was noted. She appeared brighter and more cheerful and expressed appreciation of what had been done for her. She was willing to co-operate to get well. It was also noted that she had finally accepted the suggestion concerning her attire, and had added color to the black. She would have removed the black entirely but it is against the rule of the store. She had found reading the above-mentioned book very interesting and wished to reread it many times. She related an incident which occurred two weeks previous which illustrates very clearly the change that has taken place in her mind and attitude. A year ago she attempted to visit some friends who lived out of town. On approaching the ticket office of the railroad station, she was moved by considerable emotion and thought that she saw a vision of her husband. She had visited these friends with him many times. She now turned back and went home although she had purchased her ticket. This year she was invited again to visit the same friends. She made another attempt to go. The same emotions arose in her breast when she again approached the railroad station. This time she did not purchase a ticket but went directly to the train and, with all the will power she could command, forced herself to continue her journey. She went to the home of her old-time friends and after a while found herself enjoying herself immensely. That evening she was given a room for the night, the same room and bed which she and her husband had occupied a few years previous. This again stirred up her emotions and morbid ideas; but, determined now to get well, she went to sleep, slept quite soundly, and awoke the next morning refreshed.

This detail is given to show how suggestion in the form of psychotherapy works. At this consultation the patient's attitude to the psychiatrist changed and all of his suggestions to build up her morale were accepted without resistance. She seemed to have insight at this visit which she did not have at the first examination, and to realize that, if she continued along the old path, she would become permanently mentally ill. This idea seemed to stiffen her morale and to make her determined to overcome her morbid ideas and conduct. She has also accepted the suggestion that she become interested in young children, and a visit to a children's hospital in the near future has been arranged. The patient has requested further treatments, which will be given.

This case is interesting in many ways. Despite the fact that the patient was suffering from a mental illness of rather serious import, it did not interfere apparently with her industrial efficiency. When inquiry along this line was made, her immediate superiors reported that she was an excellent saleswoman but that she seemed a little bit different because she preferred to keep to herself and confided in no one. One may speculate what the result might have been if this individual had not been referred to a psychiatrist. The patient herself had no insight into her condition before being studied, and it is questionable whether any of her family suspected that she was suffering from a mental disease. They did chide her for her morbid exaggeration and undue

prolongation of mourning, but apparently did not realize that this could mean mental disorder.

This case also illustrates the possibilities of industrial medicine in discovering latent cases of mental disease. It is quite common for individuals ill with mental disease not to be seen by physicians until the symptoms have become distinctly overt and generally of a violent character. The conscientious and astute industrial physician and nurse have a wonderful opportunity to discover these cases so that successful therapy can be instituted early. Treatment in mental disease early in its course is generally more successful and permanent than when attempted in the later stages.

The question of lues must be considered in this case. No positive diagnosis can be made without a Wassermann of the patient's blood and spinal fluid. Whether her mental disorder is related to a luetic process is problematical at the present time. An attempt will be made, however, to get the patient to cooperate in these tests later when she is in a more stable frame of mind and when there is unquestionably a complete *rapport* between patient and psychiatrist.

Case 3.—Mrs. T. C., a saleswoman, aged 49, was referred by the health department of a department store for treatment because she had been complaining of nervousness and heart trouble for some time. Examination disclosed the following important facts: The patient had been suffering from nervousness for many years but had recently become much more nervous. She complained of spells of weakness, paresthesia over her extremities, palpitation of the heart, insomnia, and an occasional headache. She noticed that she became tired more easily and felt exhausted by the time she reached home in the evening.

Her history shows that her father, now dead, was extremely alcoholic and that she has two brothers living both excessively alcoholic. Her mother is living and has been nervous as long as the patient can remember. In fact, she states that her mother has had persecutory ideas frequently and has occasionally suffered from periods of depression. Nineteen years ago the patient divorced her husband, to whom she had been married for eight years. From this union there was one son, who is now 27 years of age and who appears to be the problem which is perplexing his mother. Recently he was temporarily committed to a hospital for mental diseases. His case was diagnosed as dipsomania, and he was discharged after ten days. Apparently he was not entirely well when he was allowed to go home, for he has been showing psychotic symptoms and disturbing the sleep of his mother practically every night. Conversation with the patient brought out the fact that she is greatly disturbed about her son, is worrying whether or not he will recover from his mental disease, fears his becoming permanently insane, and would like to have medical attention for him but cannot afford to secure it on her small wages. Her son will not go to any hospital outpatient clinic or to any physician, and for this reason the mother would like to have someone see him at home. It is this problem that has made her become very nervous.

Physical examination was negative. It appears that in the case of this patient there is a nervous condition due to an apparently unresolvable and intolerable situation. Talking this over with the patient, showing her how these conflicts have caused her symptoms, and informing her that there was nothing wrong with her heart, as she had suspected, brought considerable relief. This was increased when she was told that the health department would arrange to have her son observed and cared for.

An interesting fact that this case brings to light is the psychopathic taint in the family. There is a strong history of alcoholism and a very probable case of schizophrenia in the patient's mother, who was able to make a social adjustment and did not have to receive the custodial treatment of a hospital for mental diseases. This taint, of course, is one of the factors that predispose the patient to mental disease, and the care of a psychiatrist is quite essential to

After the main facts were obtained, numerous suggestions along the lines of psychotherapy were offered to the patient which she persistently refused to accept. She did not wish to get well, and said that life on earth is short and that she would resist any attempt to lengthen her stay. She replied to the suggestion that she read certain literature that she preferred to read poems of sadness and stories of sorrow. She could not see how a change in her manner of life or her way of thinking would be of assistance to her.

After considerable questioning, the patient responded effectively to the suggestion that it would probably be desirable for her to devote some of her time to the care of others, especially young children. With considerable display of emotion and agitation she said that this alone would appeal to her and might make her life on earth more bearable; that her work at the store and her life at home were not satisfying and that an opportunity to be of service to others might fill the void in her life. Along these lines further psychotherapy was instituted and another consultation was arranged. The patient was also given a copy of Jackson and Salisbury's "Outwitting our Nerves" (6) to read in the meantime. It was not thought wise to ask for a Wassermann test until the patient was of a different frame of mind and was willing to co-operate.

She was seen again about six weeks later, when a remarkable change in her appearance and manner was noted. She appeared brighter and more cheerful and expressed appreciation of what had been done for her. She was willing to co-operate to get well. It was also noted that she had finally accepted the suggestion concerning her attire, and had added color to the black. She would have removed the black entirely but it is against the rule of the store. She had found reading the above-mentioned book very interesting and wished to reread it many times. She related an incident which occurred two weeks previous which illustrates very clearly the change that has taken place in her mind and attitude. A year ago she attempted to visit some friends who lived out of town. On approaching the ticket office of the railroad station, she was moved by considerable emotion and thought that she saw a vision of her husband. She had visited these friends with him many times. She now turned back and went home although she had purchased her ticket. This year she was invited again to visit the same friends. She made another attempt to go. The same emotions arose in her breast when she again approached the railroad station. This time she did not purchase a ticket but went directly to the train and, with all the will power she could command, forced herself to continue her journey. She went to the home of her old-time friends and after a while found herself enjoying herself immensely. That evening she was given a room for the night, the same room and bed which she and her husband had occupied a few years previous. This again stirred up her emotions and morbid ideas; but, determined now to get well, she went to sleep, slept quite soundly, and awoke the next morning refreshed.

This detail is given to show how suggestion in the form of psychotherapy works. At this consultation the patient's attitude to the psychiatrist changed and all of his suggestions to build up her morale were accepted without resistance. She seemed to have insight at this visit which she did not have at the first examination, and to realize that, if she continued along the old path, she would become permanently mentally ill. This idea seemed to stiffen her morale and to make her determined to overcome her morbid ideas and conduct. She has also accepted the suggestion that she become interested in young children, and a visit to a children's hospital in the near future has been arranged. The patient has requested further treatments, which will be given.

This case is interesting in many ways. Despite the fact that the patient was suffering from a mental illness of rather serious import, it did not interfere apparently with her industrial efficiency. When inquiry along this line was made, her immediate superiors reported that she was an excellent saleswoman but that she seemed a little bit different because she preferred to keep to herself and confided in no one. One may speculate what the result might have been if this individual had not been referred to a psychiatrist. The patient herself had no insight into her condition before being studied, and it is questionable whether any of her family suspected that she was suffering from a mental disease. They did chide her for her morbid exaggeration and undue

prolongation of mourning, but apparently did not realize that this could mean mental disorder.

This case also illustrates the possibilities of industrial medicine in discovering latent cases of mental disease. It is quite common for individuals ill with mental disease not to be seen by physicians until the symptoms have become distinctly overt and generally of a violent character. The conscientious and astute industrial physician and nurse have a wonderful opportunity to discover these cases so that successful therapy can be instituted early. Treatment in mental disease early in its course is generally more successful and permanent than when attempted in the later stages.

The question of lues must be considered in this case. No positive diagnosis can be made without a Wassermann of the patient's blood and spinal fluid. Whether her mental disorder is related to a luetic process is problematical at the present time. An attempt will be made, however, to get the patient to cooperate in these tests later when she is in a more stable frame of mind and when there is unquestionably a complete *rapport* between patient and psychiatrist.

Case 3.—Mrs. T. C., a saleswoman, aged 49, was referred by the health department of a department store for treatment because she had been complaining of nervousness and heart trouble for some time. Examination disclosed the following important facts: The patient had been suffering from nervousness for many years but had recently become much more nervous. She complained of spells of weakness, paresthesia over her extremities, palpitation of the heart, insomnia, and an occasional headache. She noticed that she became tired more easily and felt exhausted by the time she reached home in the evening.

Her history shows that her father, now dead, was extremely alcoholic and that she has two brothers living both excessively alcoholic. Her mother is living and has been nervous as long as the patient can remember. In fact, she states that her mother has had persecutory ideas frequently and has occasionally suffered from periods of depression. Nineteen years ago the patient divorced her husband, to whom she had been married for eight years. From this union there was one son, who is now 27 years of age and who appears to be the problem which is perplexing his mother. Recently he was temporarily committed to a hospital for mental diseases. His case was diagnosed as dipsomania, and he was discharged after ten days. Apparently he was not entirely well when he was allowed to go home, for he has been showing psychotic symptoms and disturbing the sleep of his mother practically every night. Conversation with the patient brought out the fact that she is greatly disturbed about her son, is worrying whether or not he will recover from his mental disease, fears his becoming permanently insane, and would like to have medical attention for him but cannot afford to secure it on her small wages. Her son will not go to any hospital outpatient clinic or to any physician, and for this reason the mother would like to have someone see him at home. It is this problem that has made her become very nervous.

Physical examination was negative. It appears that in the case of this patient there is a nervous condition due to an apparently unresolvable and intolerable situation. Talking this over with the patient, showing her how these conflicts have caused her symptoms, and informing her that there was nothing wrong with her heart, as she had suspected, brought considerable relief. This was increased when she was told that the health department would arrange to have her son observed and cared for.

An interesting fact that this case brings to light is the psychopathic taint in the family. There is a strong history of alcoholism and a very probable case of schizophrenia in the patient's mother, who was able to make a social adjustment and did not have to receive the custodial treatment of a hospital for mental diseases. This taint, of course, is one of the factors that predispose the patient to mental disease, and the care of a psychiatrist is quite essential to

prevent her from breaking down seriously in the near future.

Summary

Industrial physicians are beginning to realize the necessity of the psychiatric approach in the solution of their medical problems. This may be accomplished by a study of the personality and consideration of the mental, physical, and social factors. Many cases of functional nervous disease can be relieved or cured by this method.

Functional nervous disease includes the psychoneuroses and the neuroses. In industrial psychiatry one may meet more serious forms of mental disorder, such as schizophrenia and manic-depressive psychosis. Under the classification, "nervous disease functional," industrial physicians tend to include practically all cases diagnosed as nervous or mental disease. For the sake of prognosis and more successful treatment, more exact diagnoses are required.

The recognition of minor deviations of personality are important from the point of view of prevention.

Industrial psychiatry is a specialized type of industrial medicine and has its application in factories, mercantile establishments, and industrial outpatient clinics. Industrial psychiatry is to industrial medicine what general psychiatry is to clinical medicine.

Industrial psychiatry must not be mistaken for mental hygiene in industry. The latter is primarily interested in the preservation of the health of workers in both mental and physical spheres.

Three cases are cited with comments to indicate in a brief way the possibilities of industrial psychiatry. The first is the case of an employee with chronic headache, diagnosed as migraine, who was on the point of being discharged but was reclaimed through the use of simple methods of psychotherapy. The second is a case of mental disease where the patient's chief symptom was prolonged and exaggerated mourning following the death of her husband. Although resisting psychotherapy at the beginning, this patient became an interested, co-operating patient at the end of a few weeks and is now on the road to recovery. Lues is suspected but has not yet been proved. The third case is that of a mother working as a saleswoman in a department store. Prevention was stressed in this case because there is a strong psychopathic taint in her family which culminated in her only son's becoming a victim to alcoholic insanity. The patient's worries and the care of her son were burdens too heavy for her to bear and resulted in symptoms of nervousness which caused her to suspect that she was suffering from heart disease. The use of psychotherapy is helping this patient to adjust herself to difficult and unpleasant situations.

Bibliography

1. Dershimer, F. W.: Practical Mental Hygiene in Industry. This Jour., 1923-1924, *5*, 1.
2. Dershimer, F. W.: Further Studies in Mental Hygiene in Industry: Malingering. *Ibid.*, p. 299.
3. Stevens, H. W.: The Psychic Aspect of Industrial Disability. Bull. Mass. Dept. Mental Dis., 1923, *7*, 3.
4. Elkind, H. B.: Mental Hygiene in Industry. This Jour., 1924-1925, *6*, 113.
5. Tead, O., and Metcalf, H. C.: Personnel Administration. Its Purpose and Practice. New York, McGraw-Hill Book Company, 1920.
6. Jackson, J. A., and Salisbury, H. M.: Outwitting our Nerves. New York, Century Company, 1921.

J. I. H.
Oct., 1924

STATUS OF THE OCCUPATIONAL DISEASE QUESTION IN OHIO, BASED ON OFFICIAL FIGURES. RETROSPECT AND PROSPECT*

EMERY R. HAYHURST, M.D.

Professor of Hygiene, Ohio State University, and Consultant in Industrial Hygiene, Ohio State Department of Health

RETROSPECT

OHIO was one of the first states to recognize the significance of occupational diseases. On page 10 of the annual report of the Ohio State Board of Health, which was organized in 1886, it is recorded that the President appointed a Standing Committee on Hygiene of Occupations and Railway Sanitation, with Dr. John D. Jones, of Cincinnati, as chairman. Subsequent annual reports for some years contain reports from this committee. Industrial hygiene seems then to have lost its identity.

The State Bureau of Vital Statistics published annual tables of occupations *versus* causes of death from 1910 to 1914. The figures for the first three years were printed in time to be included in the state's survey of occupational diseases reported in 1915.

When the State Industrial Commission was created in 1912, the administrative and executive features of industrial hygiene were brought within its scope through the department of factory inspection.

In 1913 the state legislature ordered an investigation and study of occupational diseases and their underlying causes to be made by the State Board of Health, and made an appropriation for a two-year period. The same legislature passed the so-called "lead law," the occupational disease reporting features of which were under the supervision of the Board of Health; and, more important, this legislature passed the act requiring the reporting of all occupational diseases by physicians to the State Board (now Department) of Health.

In February, 1915, an official report was made to the legislature by the State Board of Health in a volume entitled "A Survey of Industrial Health Hazards and Occupational Diseases in Ohio." This report covered 1,067 establishments employing 235,984 wage-earners (estimated to be about half of those industrially employed), but did not include coal mining, transportation, mercantile work, or professions. The legislature thereupon made provision for a Division of Industrial Hygiene in the State Department of Health to continue investigation and research and to promote educational work on the subject.

In 1918 an investigation and report on the health aspects of the coal mining industry in Ohio, which employed about 50,000 wage-earners, was completed and reported by the State Department of Health, in conjunction with the Health and Old Age Insurance Commission.

Concurrent with some of these activities of the Department of Health, the Industrial Commission (whose administrative functions are now carried on by the Department of Industrial Relations) was devising various safety and

*Read before the Medical Science Section of the Ohio Academy of Science, at the annual meeting, April 18, 1924, Columbus, Ohio. Received for publication April 26, 1924.

health codes for factories and workshops (foundries, potteries, metal and woodworking industries, elevators, explosives).

The experience regarding occupational diseases accumulated by the State Department of Health was used as the basis for a schedule of diseases, to be compensated similarly to industrial accidents, which was embodied in a legislative act in 1921. This schedule includes the following fifteen diseases:

1. Anthrax.
2. Glanders.
3. Lead poisoning.
4. Mercury poisoning.
5. Phosphorus poisoning.
6. Arsenic poisoning.
7. Poisoning by benzol or by nitro and amido derivatives of benzol (dinitrobenzol, aniline, and others).
8. Poisoning by gasoline, benzine, naphtha, or other volatile petroleum products.
9. Poisoning by carbon bisulphide.
10. Poisoning by wood alcohol.
11. Infection or inflammation of the skin on contact surfaces due to oils, cutting compounds or lubricants, dust, liquids, fumes, gases or vapors.
12. Epithelioma—cancer or ulceration of the skin or of the corneal surface of the eye due to carbon, pitch, tar or tarry compounds.
13. Compressed air illness.
14. Carbon dioxide poisoning.
15. Brass or zinc poisoning.

The legislature of 1921 also empowered the Industrial Commission to investigate and ascertain the hazards which produce the fifteen disease conditions specified so that, although funds were set aside[1] for immediate compensation purposes, the Commission, after July 1, 1924, would be able to classify occupations and industries according to the degree of hazard found in each in order to fix premium rates to provide an adequate fund for compensation payments in the future. The Commission was also empowered to "employ and detail to such (investigative) work such physicians, examiners, clerks and assistants as shall be necessary." On account of the failure to provide sufficient funds for this purpose, however, only one part-time physician was eventually employed to make these special investigations. He was aided by the regular medical examining staff employed for accident claims. Necessarily, only cases of an especially controversial nature were investigated, and some of these had to be turned over to outside specialists. An amendment to the act creating the Industrial Commission, permitting the use of 1 per cent. of the total premium income for preventive work, finally received the endorsement of the electorate in November, 1923. This now awaits an empowering act by the legislature at its next session. By the Act of 1921, the Commission was also empowered to publish from time to time such conclusions as it might reach as to the causes and prevention of the occupational diseases investigated. Thus far no report has been published, but the Commission has instructed a special committee of three physicians, including its own occupational disease physician, to draw up a prospective code based upon its experience with occupational diseases. A preliminary report on this code has been submitted and after proper hearings will probably be molded into the first publication by the Commission along this line. By the same act, physicians are required to report the fifteen occupational diseases in the schedule to the Industrial Commission. This results in double reporting since the Act

[1]The provision was 2½ cents per $100 payroll which, up to Dec. 31, 1923, created a fund of $623,000 to which should be added $28,000 catastrophe reserve from self-insurers. This figure of $28,000 is 10 per cent. of the premium self-insurers would pay were they under the fund.

of 1913 requires them to be reported, along with all other occupational diseases, to the State Department of Health.

The total number of cases of true occupational diseases reported to the State Department of Health since the reporting law became effective (May 15, 1913, to Dec. 31, 1923) is 4,004. Of this number, 862 were reported (and largely found) by the survey which was completed in December, 1914. (The survey also reported 211 tentative cases, 301 industrial tuberculosis cases, and 39 miscellaneous, making a total of 1,415 cases during its seventeen months of field work.)

The occupational diseases officially reported to the State Department of Health prior to the adoption of the Compensation Law (Aug. 4, 1921) were as follows:

Occupational Disease	*Number of Cases*
Lead poisoning	998
Brass and zinc poisoning	131
Carbon monoxide poisoning	101[1]
Aniline poisoning	71
Benzine and benzol poisoning	39
Para-nitraniline poisoning	24
Arsenic poisoning	20
Wood alcohol	16
Other industrial poisons	60
Dermatitis	655
Others (not including tuberculosis)	159
	2,274

[1]Most of these were accidents or sequelae thereof, following a single exposure, rather than disease, the result of multiple exposure.

The occupational diseases which have been reported to both the Ohio State Department of Health and the State Department of Industrial Relations since the date when the Compensation Act went into effect—that is, between Aug. 4, 1921, and Dec. 31, 1923—are as follows:

Occupational Disease	*Department of Health*	*Department of Industrial Relations*
Ammonia poisoning	1	0
Aniline poisoning	7	0
Arsenic poisoning	8	3
Benzine and benzol poisoning	29	29[1]
Carbon monoxide poisoning	3	0
Dermatitis	1,356	841[2]
Lead poisoning	297	260
Mercury poisoning	4	1
Para-nitraniline poisoning	3	0
Zinc (brass) poisoning	6	14
Anthrax	0	1
Other poisons	10	1
Other occupational diseases[3]	6	61
Reported by self-insurers[4] (Not classified)	—	326
	1,730	1,537[5]

[1]Benzol, 24; gasoline, 5.

[2]Fully one-half are due to oil dermatitis.

[3]Not in schedule for compensation.

[4]Of the 29,271 subscribers (employers) to the Ohio fund on May 1, 1924, only 409 were authorized (as self-insurers) to pay compensation directly to injured employees; in other cases compensation was paid directly by the state. By Section 1465-101 of the Ohio General Code, employers cannot indemnify themselves by re-insuring their liabilities, so that self-insurers are invariably large corporations, who are usually large employers in the state, as may be seen from the fact that they employed 389,091 of the total of 1,434,757 protected employees in the state (April, 1923). Compensation under self-insurers is carefully supervised by the state, as each release must have the approval of the Industrial Commission. Self-insurers have decreased in number, largely because of changes in governing statutes, from approximately 12,000 in 1914 to 409 as of May 1, 1924. Theoretically the employee in Ohio is as well-protected under the self-insurer as under the state, and self-insurers are more apt to supply comprehensive industrial medical and welfare services.

[5]Of this number 30 proved fatal.

About 95 per cent. of the occupational diseases thus far reported for compensation are actually compensated; not over 7 per cent. become controversial or are questioned as to justness of claim. Of these, a few require special investigations and some a formal hearing. Of the fatal cases, only about one-third have been allowed, most of the rest being still under investigation.

Figures for the cost of occupational disease claims already allowed are at hand only to Dec. 31, 1922, or for approximately the first seventeen months of experience. For this period, claims allowed, other than deaths, amounted approximately to $35,000; five death claims totaling $25,527 bring the total to about $60,500. The premiums collected for this period of seventeen months amounted to $301,000 to which should be added $12,000 received from self-insurers as catastrophe reserve. Since not all claims for the first seventeen months have yet been settled, there is a possibility that the total will be approximately $80,000 to $90,000, not including self-insurers. Thus it can be seen that the estimated premium has yielded a fund several times in excess of the cost and the reserve required by law. As time progresses the levy for occupational diseases necessarily will be reduced.[2]

Prospect

The present tendencies regarding the occupational disease question in Ohio concern especially (*a*) the question of extending the schedule of industrial diseases open to compensation and (*b*) extension of the methods of prevention and control. In this paper I shall consider especially the first of these two questions.

There is much evidence that employees suffering from occupational diseases which are already included in the schedule fail to receive compensation because of their ignorance of the existence of the law providing for it. This is a matter of extending information to employers, employees, and physicians. It will probably be some years before such oversights will cease to exist. It is to be noted also that a waiting period of one week is necessary before compensation begins, although medical attendance is paid for from the onset of illness.

There is much evidence that other occupational diseases than those included in the fifteen items in the schedule should be compensated. A general provision or construction of the law to cover any and all occupational diseases, as is the case in Massachusetts, California, Wisconsin, and Connecticut, would be fairer than providing only for those in a given schedule.[3] Albeit, this is the English and provincial system—now followed by the states of Illinois, Minnesota, New York, and Ohio. Only the eight states mentioned compensate occupational diseases in this country at the present time. Employees of the Federal Government are covered in a rather broad federal act.

An examination of the diseases included in the New York schedule which are not covered by the Ohio schedule may perhaps suggest items which should be added to the present Ohio list:

1. Poisoning by nitrous fumes.
2. Poisoning by nickel carbonyl.

[2]An actuarial difficulty in collecting the premium for occupational diseases arises from the fact that the law provides separate rating by classification according to industries. Since there are approximately 750 active industrial groups, this provision results, very many times, in the assignment of only a few cents for the occupational disease risk against the premium paid semi-annually by a single employer. It would appear that the total cost of occupational disease claims, even for a much more extended list of such diseases than is now covered, is certain to be so little, compared to that for industrial accident claims, that the former might best be dropped as a separate premium classification, especially inasmuch as the claim cost can still be classified so as to give the actuarial information desired for guiding future procedure.

[3]The Secretary of the State Federation of Labor advocates that the State Department of Health be given power to certify all claims not included in the schedule.

J. I. H.
Oct., 1924

3. Dope poisoning (airplane varnish).
4. Formaldehyde poisoning.
5. Chrome ulceration (meaning ulceration of the mucous membranes of the nose and upper respiratory tract only, if such ulceration were to be included in the Ohio schedule, since skin affections are already covered).
6. Miners' diseases, including cellulitis, bursitis, ankylostomiasis, tenosynovitis, and nystagmus.
7. Cataract in glass workers (puddlers should also be included for Ohio).

We cannot presume that these seven additional items included in the New York schedule, which was passed a year or so before Ohio's schedule, are essentially the main ones to be considered for Ohio, particularly in view of the experience of the past few years in Ohio and in neighboring states. Personally, however, I should endorse six of these seven affections and include the seventh one, "Miners' diseases," under a rephrasing (see No. 7 of the following list), dropping ankylostomiasis and nystagmus entirely as there is no evidence of their existence as occupational diseases in Ohio. In addition, the following affections deserve especial consideration:

1. Silicosis (fibroid phthisis due to inhaling silicious dust) occurring in any process involving exposure to the inhalation of silicious dust. Diagnosis of this condition is based on (*a*) the presence of silica in expectorated lung excretions (since silica is not a normal constituent of human lungs, its presence in sputum is proof of outside origin); (*b*) physical findings of fibroid phthisis, with or without associated tuberculosis (the latter is a complication or coexisting disease and is not the factor to be compensated); and (*c*) X-ray findings showing the disease *silicosis* to be present. The mere presence of silica in the lung passage-ways, as after temporary exposures, fortunately is not shown and also would not constitute silicosis. A history of work exposure to silica dust also is to be proved. The first British report on compensating this condition, after an experience of five years, is now at hand and, combined with the South African reports covering nearly twelve years, shows its entire feasibility and justification.

2. Poisoning by chlorine, bromine or iodine derivatives of petroleum products, such as carbon tetrachloride, tetrachlorethane, carbon oxychloride (phosgene), methyl bromide, methyl iodide and others, occurring in industrial processes. The growth and extension of the organic chemical industries and especially coal tar dyes and similar products would justify including these. The total number of workers exposed would be small, but European as well as our own experience amply calls for compensation for them.

3. Poisoning by hydrogen sulphide. There would appear to be every reason for including this substance, which is equally as poisonous as carbon bisulphide, now included. Not many workers, fortunately, are exposed to disabling amounts of this gas.

4. Poisoning by carbon monoxide. There is little statistical evidence for including this in the Ohio schedule since sequelae are not recognized and there is usually such an interval between acute gassing and the disabling effects of carbon monoxide poisoning that such effects would constitute sequelae. Acute poisoning, shown as above, comes under accidents, and delayed recovery (or death) is now generally recognized as part of the accident complication.

5. Poisoning by turpentine. This substance is one of the most poisonous with which workers have to contend. Even its odor affects many, although usually not to a disabling extent. The breathing of minute traces of it, however, as in spraying paint from atomizing guns, rapidly produces signs of intoxication, usually with severe kidney inflammation, bloody urine, and perhaps uremia.

6. Poisoning by sulphuric ether. The symptoms appear to be accumulative and of the order of uremia. A few workers only are exposed in Ohio.

7. Cellulitis, bursitis or tenosynovitis of the hand, wrist, elbow or shoulder from any work involving continuous local pressure, twisting, or straining of parts named. These features are now included in the New York law in the case of miners only, but as such they are rarely reported in Ohio. On the other hand, they are fairly common in many other industries, especially among new workers or those just returning from a period of idleness who attempt to turn out the old "day's output" before they are again accustomed to the work. Some cases become